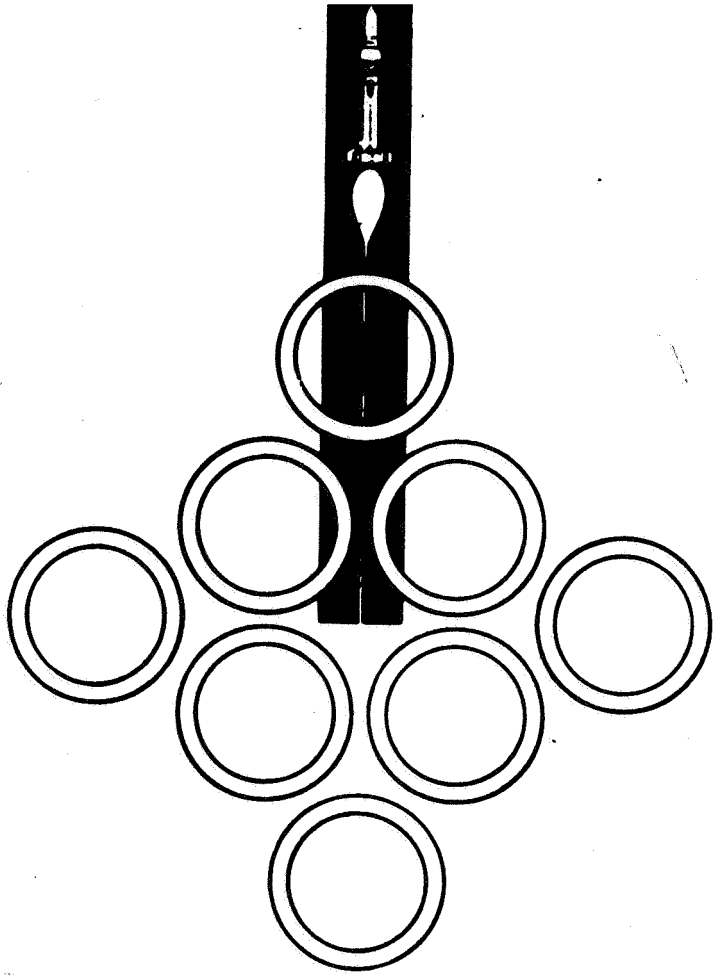

ENGINEERING DEPARTMENT
TECHNICAL REPORT
TR-RE-CCSD-FO-1139-3

TEST REPORT

FOR

DUAL BALL SHUTOFF VALVE

Flodyne Controls, Inc., Part Number 5C151

NASA Drawing Number 75K26264

SPACE DIVISION CHRYSLER CORPORATION

TEST REPORT

FOR

DUAL BALL SHUTOFF VALVE, $\frac{1}{2}$-INCH, 1500 PSIG, CAM OPERATED

Flodyne Controls Inc. Part Number 5C151

NASA Drawing Number 75K26264

ABSTRACT

This report presents the results of test performed on three specimens of Cam Operated Dual Shutoff Valve 75K26264. The following tests were performed:

1. Receiving Inspection
2. Proof Pressure
3. Functional
4. Low Temperature
5. High Temperature
6. Vibration
7. Salt Fog
8. Life Cycle
9. Repeatability
10. Shaft Travel and Ball Rotation
11. Flow
12. Burst

The three Cam Operated Dual Ball Shutoff Valves met the requirements of NASA Drawing 75K26264 and TP-RE-CCSD-FO-1139-2 throughout the test program.

TEST REPORT

FOR

DUAL BALL SHUTOFF VALVE

FLODYNE CONTROLS INC., PART NUMBER 5C151

NASA DRAWING NUMBER 75K26264

April 10, 1968

CHRYSLER CORPORATION SPACE DIVISION, NEW ORLEANS, LOUISIANA

FOREWORD

This document was prepared by Chrysler Corporation Space Division, Michoud Assembly Facility, under Contract NAS 8-4016, Part VII, CWO 271620.

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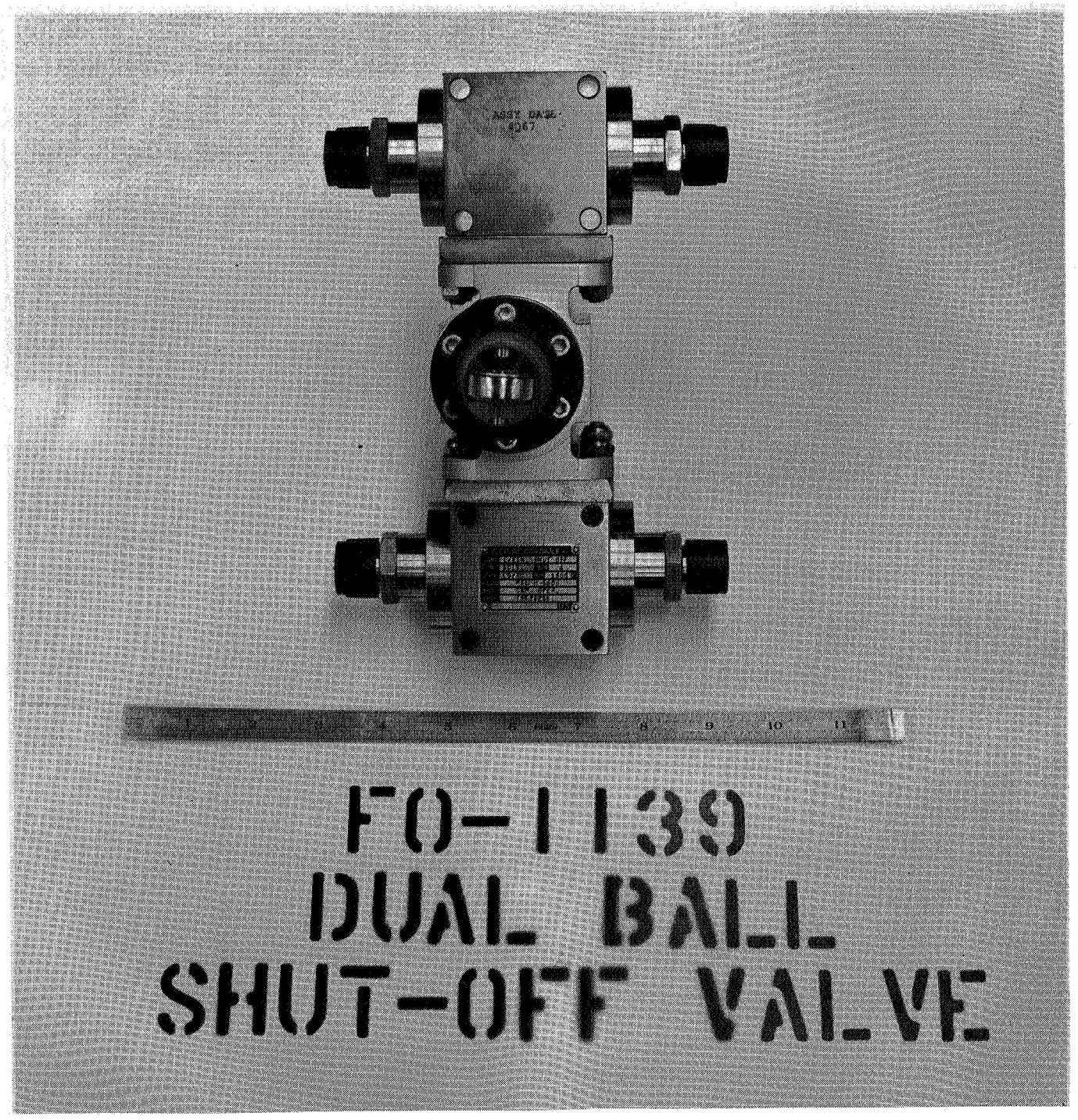


75K26264, ½-Inch, 1500-Psig, Cam Operated

CHECK SHEET

FOR

DUAL BALL SHUTOFF VALVE

Manufacturer: Flodyne Controls, Inc.

Manufacturer's Part Number: 5C151

NASA Drawing Number: 75K26264

Testing Agency: Chrysler Corporation Space Division, New Orleans, Louisiana

Authorizing Agency: NASA-KSC

I. FUNCTIONAL REQUIREMENTS:

A. Operating Medium: MIL-H-5606

B. Operating Pressure: 1500 psig

C. Leakage at 1500 psig: External - None

Internal - 5 cc per minute each side

D. Actuation Force at 1500 psig: 550 pounds max

II. CONSTRUCTION:

A. Body: Series 300 Stainless Steel

B. Seals: Teflon

III. ENVIRONMENTAL REQUIREMENTS:

Operating Temperature Range: -65 to + 160°F

IV. LOCATION AND USE:

The valve is used as a braking device in the swing arm 1, 2, 3, and 4 systems.

TEST SUMMARY

DUAL BALL SHUTOFF VALVE, ½-INCH, 1500 PSIG, CAM OPERATED

75K26264

ENVIRONMENT	UNITS	OPERATIONAL BOUNDARY	TEST OBJECTIVES	TEST RESULTS	REMARKS
Proof Pressure Test	3	3000 Psig	Check for leakage and distortion.	Satisfactory	No leakage or distortion.
Functional Test	3	1500 Psig at 10 GPM	Determine closing force and leakage.	Satisfactory	Closing force in limits and no leakage.
Low Temperature Test	2	+25°F (+0,-4°F)	Determine if specimen operation is impaired by low temperature.	Satisfactory	
High Temperature Test	2	125°F (+4,-0°F)	Determine if specimen operation is impaired by high temperature.	Satisfactory	
Vibration: Sinusoidal Random	2	10 to 18 cps @ 0.3 inches D.A. 18 to 48 cps @ 5.0g peak 48 to 90 cps @ 0.05 inches D.A. 90 to 2000 cps @ 20.0g peak 10 to 1000 cps @ 0.35g 2/cps 1000 to 2000 cps @ -6 db/ octave	Determine if specimen operation is impaired by vibration.	Satisfactory	
Salt Fog Test	2	240 (± 2) hours exposure to atomized salt solution.	Determine if specimen operation is impaired by salt fog.	Satisfactory	

TEST SUMMARY (CONTINUED)

ENVIRONMENT	UNITS	OPERATIONAL BOUNDARY	TEST OBJECTIVES	TEST RESULTS	REMARKS
Life Cycle Test	1 2	5000 cycles 2500 cycles	Determine if specimen operation is impaired by cycling.	Satisfactory Satisfactory	
Repeatability Test	3	NA	To measure the shaft travel required to flow and determine the variance between actuation cycles.	Satisfactory	
Shaft Travel and Ball Rotation Test	3	NA	To correlate the degrees of ball rotation with shaft travel from 0 to .550 inches.	Satisfactory	
Flow Test	1	NA	To correlate the flow rate at a ΔP of 1500 psig with actuator shaft position.	Satisfactory	
Burst Test	2	Valve open - 4500 psig for 5 min. Valve closed - 1500 psig for 5 min., then, 4500 psig for 5 min.	To determine if specimen will maintain burst pressure without leakage.	Satisfactory	

SECTION I

INTRODUCTION

1.1 SCOPE

1.1.1 This procedure describes the tests to be performed to determine if Dual Ball Shutoff Valve 75K26264 meets the operational and environmental requirements for the John F. Kennedy Space Center Launch Complexes 34 and 37B. A summary of the test results is presented on pages xii and xiii.

1.1.2 Three valves shall be tested. Table 1-1 lists the tests to be performed and the test media.

1.2 ITEM DESCRIPTION

Dual Ball Shutoff Valve 74K26264 is manufactured by Flodyne Controls, Inc. as vendor part number 5C151. The valve has separate cavaties with an operating pressure of 1500 psig. Operating media is MIL-H-5606 hydraulic fluid. The valve measures 7.5 by 4.0 by 7.8 inches.

1.3 APPLICABLE DOCUMENTS

1.3.1 The following documents contain the test requirements for Dual Ball Shutoff Valve 75K26264.

a. KSC-STD-164(D), Standard Environmental Test Methods for Ground Support Equipment Installations at Cape Kennedy.

b. NASA Drawing 75K26264

c. Cleaning Standard MSFC-STD-164

d. Test Plan CCSD-FO-1139-1

e. Test Procedure TP-RE-CCSD-FO-1139-2

Table 1-1. Test Sequence and Media

Test Sequence	Section	Medium	Specimen		
			1	2	3
Receiving Inspection	II		X	X	X
Proof Pressure	III	Hydraulic Fluid	X	X	X
Functional	IV	Hydraulic Fluid	X	X	X
Low Temperature	V	Hydraulic Fluid	X	X	
High Temperature	VI	Hydraulic Fluid	X	X	
Vibration	VII	Hydraulic Fluid		X	X
Salt Fog	VIII			X	X
Life Cycle	IX	Hydraulic Fluid	X	X	X
Repeatability	X	Hydraulic Fluid	X	X	X
Shaft Travel and Ball Rotation	XI		X	X	X
Flow	XII	Hydraulic Fluid	X		
Burst	XIII	Hydraulic Fluid	X	X	

SECTION II

RECEIVING INSPECTION

2.1 TEST REQUIREMENTS

Each specimen shall be visually and dimensionally inspected for conformance with the applicable specifications prior to testing.

2.2 TEST PROCEDURE

A visual and dimensional inspection was performed on each specimen to determine compliance with NASA Specification 75K26264 Flodyne Controls, Inc. drawing number 5C151 to the extent possible without disassembling the specimen. At the same time the specimen was also inspected for poor workmanship and manufacturing defects.

2.3 TEST RESULTS

The three specimens complied with NASA drawing 75K26264 and Flodyne Controls, Inc. drawing number 5C151. No evidence of poor workmanship or manufacturing defects were observed.

2.4 TEST DATA

The data presented in table 2-1 were recorded during the receiving inspection.

Table 2-1. Specimen Specifics

Name	Flodyne Controls Inc. Cam Operated Dual Ball Shutoff Valve
Type	Normally Open
Flodyne P/N	5C151
Flodyne S/N	1 (Specimen 1) 4 (Specimen 2) 9 (Specimen 3)
Service Fluid	Hydraulic Fluid MIL-H-5606
Material	Series 300 Stainless Steel
Operating Pressure	1500 Psig
Customer Specification	75K26264

SECTION III

PROOF PRESSURE TEST

3.1 TEST REQUIREMENTS

Each specimen shall be pressurized with MIL-H-5606 hydraulic fluid to a proof pressure of 3000 psig. This pressure shall be maintained for 5 minutes and the specimen shall be checked for external leakage and distortion.

3.2 TEST PROCEDURE

3.2.1 The test specimen was installed as shown in figures 3-1, 3-2 and 3-3 utilizing the equipment listed in table 3-1.

3.2.2 It was determined that all connections were tight, gages were installed and operating properly, and all valves were closed.

3.2.3 Hand valves 3 and 5 were opened.

3.2.4 Using hand pump 2, MIL-H-5606 hydraulic fluid was pumped through the test setup until the system and specimen were free of air.

3.2.5 Hand valve 5 was closed and using hand pump 2, the specimen was pressurized until a 3000 psig was indicated by gage 4. This pressure was maintained for 5 minutes while the specimen was checked for external leakage and distortion. The pressure was then vented.

3.2.6 All data were recorded.

3.3 TEST RESULTS

The test specimens successfully completed the proof pressure test. No external leakage or distortion was noted.

3.4 TEST DATA

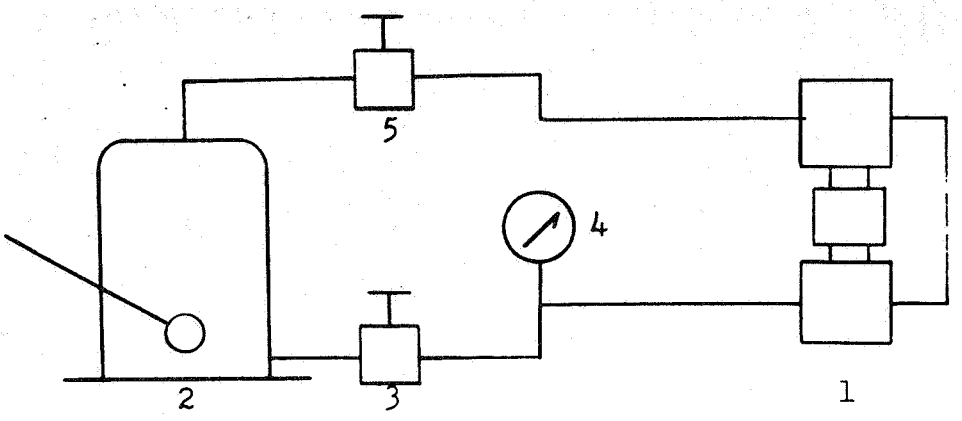
The data recorded during the proof pressure tests are presented in table 3-2.

Table 3-1. Proof Pressure Test Equipment List

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
1	Specimen	Flodyne Controls Inc.	5C151	1, 4, 9	Dual Ball Valve ½-Inch 1500 psig
2	Hand Pump	Wm. S. Pine, Inc.	160-3		0 to 5000 psig
3	Hand Valve	Robbin Aviation	SSKG-250-4T	NA	¼-Inch
4	Pressure Gage	Marsh Inst.	NA	95-1184B	0 to 10000 psig ± 0.1% FS Cal date 11-28-67
5	Hand Valve	Robbin Aviation	SSKG-250-4T	NA	¼-Inch

Table 3-2. Proof Pressure Test Data, All Specimens

Test Media	MIL-H-5606
Pressure	3000 psig
Duration	5 minutes
Leakage	None
Distortion	None



Note: All lines $\frac{1}{4}$-Inch

Refer to table 3-1 for item identification.

Figure 3-1. Proof Pressure Test Schematic

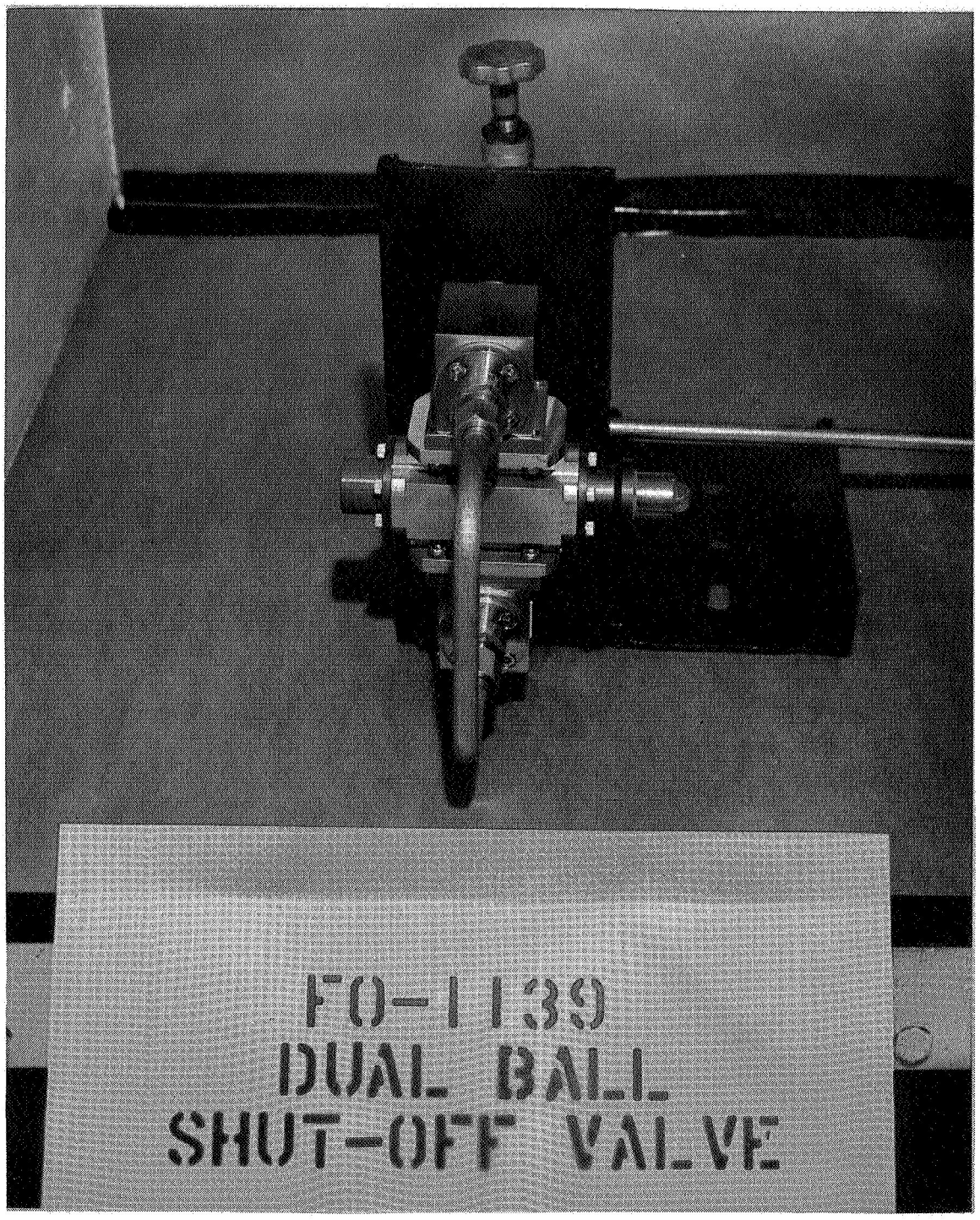


Figure 3-2. Proof Pressure and Burst Test Setup

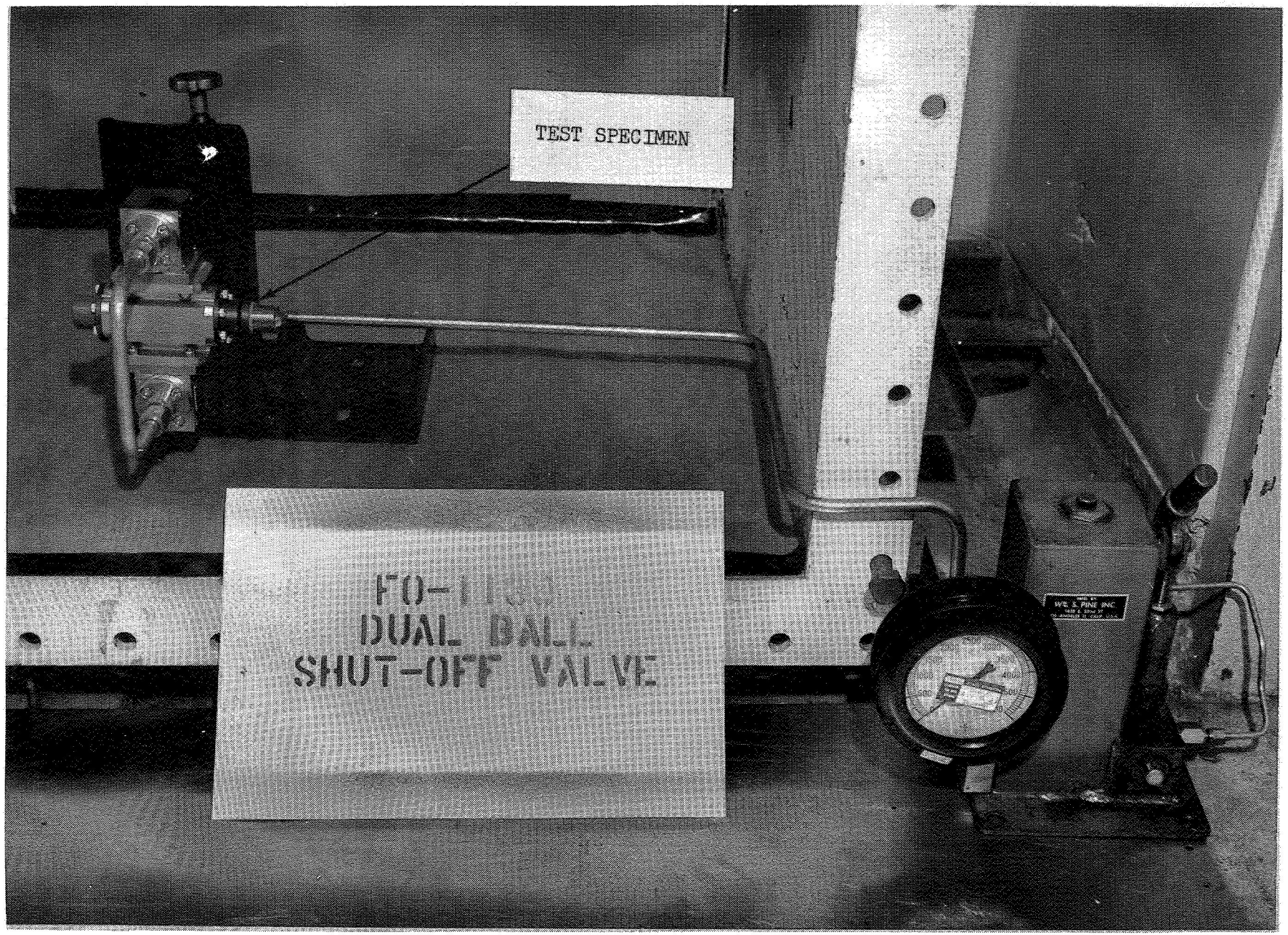


Figure 3-3. Proof Pressure and Burst Test Setup

SECTION IV

FUNCTIONAL TEST

4.1 TEST REQUIREMENTS

4.1.1 A functional test shall be conducted on each specimen to determine the force required to close the specimen and to determine the leakage.

4.1.2 Using MIL-H-5606 hydraulic fluid as the pressure medium, establish 10 gpm flow at 1500 psig through the specimen. Close the specimen and measure the closing force. The closing force shall not exceed 550 lbs.

4.1.3 With the specimen closed, pressurize one side to 1500 psig. Measure leakage at the outlet.

4.2 TEST PROCEDURE

4.2.1 The specimen was installed as shown in figures 4-1 and 4-2 utilizing the equipment listed in table 4-1.

4.2.2 It was determined that all connections were tight, all gages were installed and operating properly, and all valves were closed.

4.2.3 Pump 2 was started and the outlet pressure, as indicated by gage 3, was adjusted to 1500 psig. Hand valves 6 and 7 were slowly opened until an operating medium flow of 10 gpm was indicated by flowmeters 4 and 5.

4.2.4 Hand valve 20 and solenoid valve 9 were opened, and regulator 10 was adjusted until the specimen closed. The closing pressure, indicated by pressure gage 18, was monitored and then converted to force.

4.2.5 Hand valves 6 and 7 were closed. Hand valves 13 and 14 were opened and the internal leakage was measured by graduated cylinders 15 and 16.

4.2.6 Hand valves 13 and 14 were closed. Solenoid valve 9 was actuated and cylinder 8 vented. Pump 2 was then shut down.

4.2.7 The specimen was installed in reverse to that shown in figure 4-1, thus the flow through the specimen was reversed. Steps 4.2.3 through 4.2.6 were repeated.

4.2.8 All test data were recorded.

4.3 TEST RESULTS

All three test specimens successfully met the functional test requirements.

4.4 TEST DATA

Data recorded during the functional test are presented in tables 4-2 through 4-4.

Table 4-1. Functional, Temperature, and Life Cycle Test Equipment List

Item No.	Item	Manufacturer	Model Part No.	Serial No.	Remarks
1	Specimen	Flodyne Controls, Inc.	5C151		
2	Pump	Denison Eng. Corp.	PV08-035-51 L-02	3833	
3	Pressure Gage	Marsh Inst. Co.	NA	95-1184B	0 to 3000 psig Cal. date 11-28-67
4	Flowmeter	Cox	AN-12	019167	0 to 30 GPM Cal. date 1-25-68
5	Flowmeter	Waugh	FL-12-SR1	106-1030-B	0 to 20 GPM Cal. date 11-4-67
6	Hand Valve	Vacco Valve Co.	NV-6P-403-2	NA	$\frac{1}{2}$-inch
7	Hand Valve	Vacco Valve Co.	NV-6P-403-2	NA	$\frac{1}{2}$-inch
8	Cylinder	Parker-Hannfin	CC-2AS14C	F-95985	2-inch bore
9	Solenoid Valve	Marotta Valve Co.	MV-74V	824	$\frac{1}{4}$-inch
10	Regulator	Grove Valve & Regulator Co.	15-LXH	L-41407	0 to 3000 psig
11	Hand Valve	Robbins Aviation	SSKG-250-4T	NA	$\frac{1}{4}$-inch
12	Reservoir				
13	Hand Valve	Grove Valve Co.	M-149-18B	NA	$\frac{1}{4}$-inch
14	Hand Valve	Grove Valve Co.	M-149-18B	NA	$\frac{1}{4}$-inch
15	Graduated Cylinders	CCSD	NA	NA	
16	Graduated Cylinders	CCSD	NA	NA	
17	Pressure Gage	Acco Helicoid	NA	200506-AA	0 to 500 psig Cal. date 9-26-67
18	Pressure Gage	Ashcroft Corp.	NA	95-1403	0 to 200 psig Cal. date 10-14-67
19	Timer	Cramer Controls	540	3336A	
20	Hand Valve	Grove Valve Co.	10983KA2A	NA	$\frac{1}{4}$-inch

Table 4-1. Continued

Item No.	Item	Manufacturer	Model Part No.	Serial No.	Remarks
21	Solenoid Valve	Marotta Valve Co.	MV-74	739	$\frac{1}{4}$-inch
22	Pressure Transducer	CEC	4-350-0001	95-1122-B	0 to 3000 psig Cal. date 11-15-67
23	Pressure Transducer	CEC	4-350-0001	95-1119B	0 to 3000 psig Cal. date 11-6-67
24	Temperature Chamber	CCSD	NA	NA	
25	Thermotron	Thermotron Inc.	NA	200895-13	-100 to +400°F
26	Thermocouple	Honeywell	728097-004	NA	

Table 4-2. Initial Functional Test Data

Specimen No. 1

TEST DATA SHEET

Flow Direction	Test Media	Pressure (Psig)	Flow (Gpm)	Closing Force (Pounds)	Leakage	
					Int	Ext
Inlet	Mil-H-5606	1500	10	271	None	None
Outlet	Mil-H-5606	1500	10	272	None	None

Table 4-3. Initial Functional Test Data

Specimen No. 2

TEST DATA SHEET

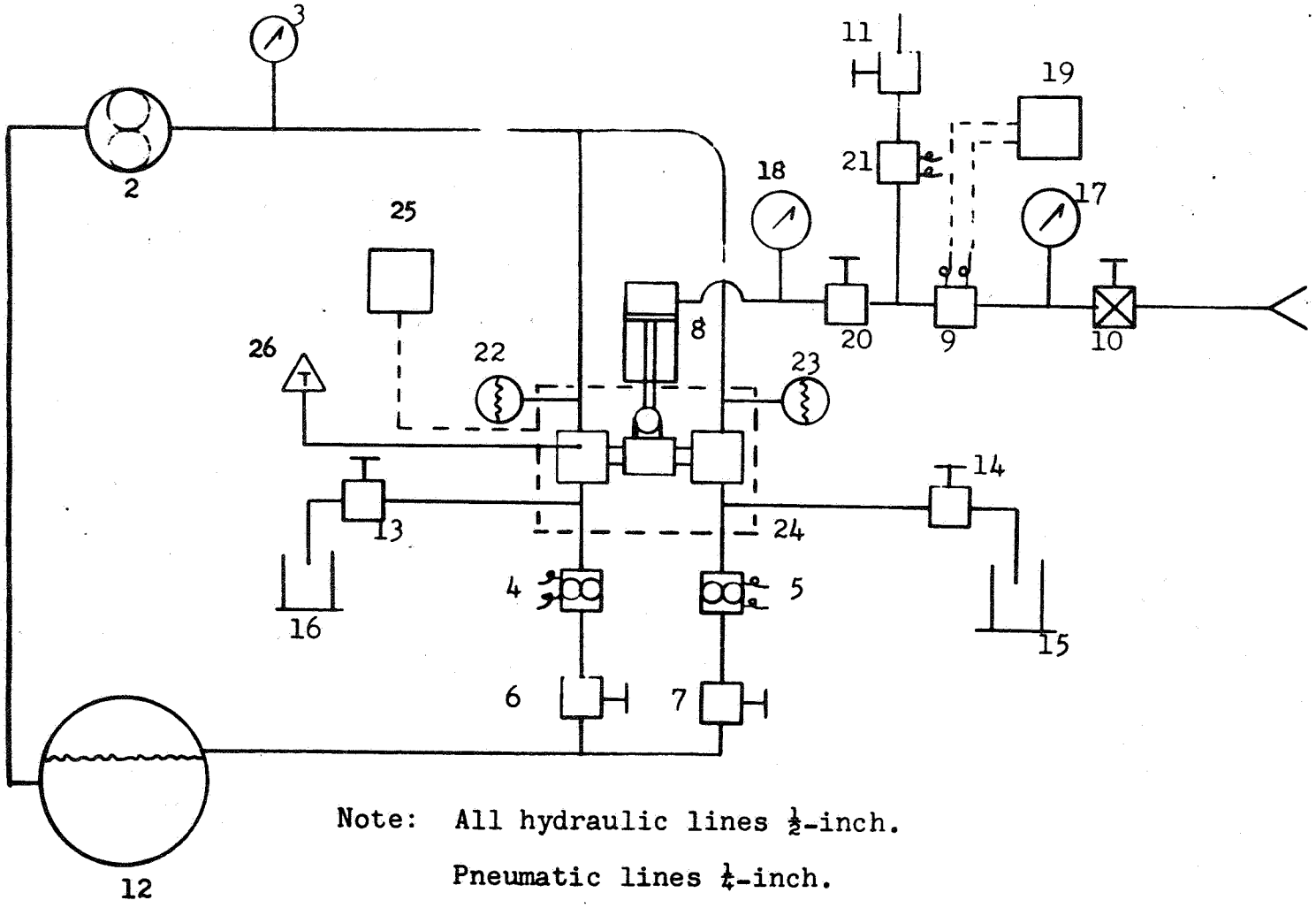
Flow Direction	Test Media	Pressure (Psig)	Flow (Gpm)	Closing Force (Pounds)	Leakage	
					Int	Ext
Inlet	Mil-H-5606	1500	10	278	None	None
Outlet	Mil-H-5606	1500	10	262	None	None

Table 4-4. Initial Functional Test Data

Specimen No. 3

TEST DATA SHEET

Flow Direction	Test Media	Pressure (Psig)	Flow (Gpm)	Closing Force (Pounds)	Leakage	
					Int	Ext
Inlet	Mil-H-5606	1500	10	292	None	None
Outlet	Mil-H-5606	1500	10	301	None	None



Note: All hydraulic lines ½-inch.

Pneumatic lines ¼-inch.

Refer to Table 4-1 for item identification.

Figure 4-1. Functional, Temperature, and Life Cycle Test Schematic

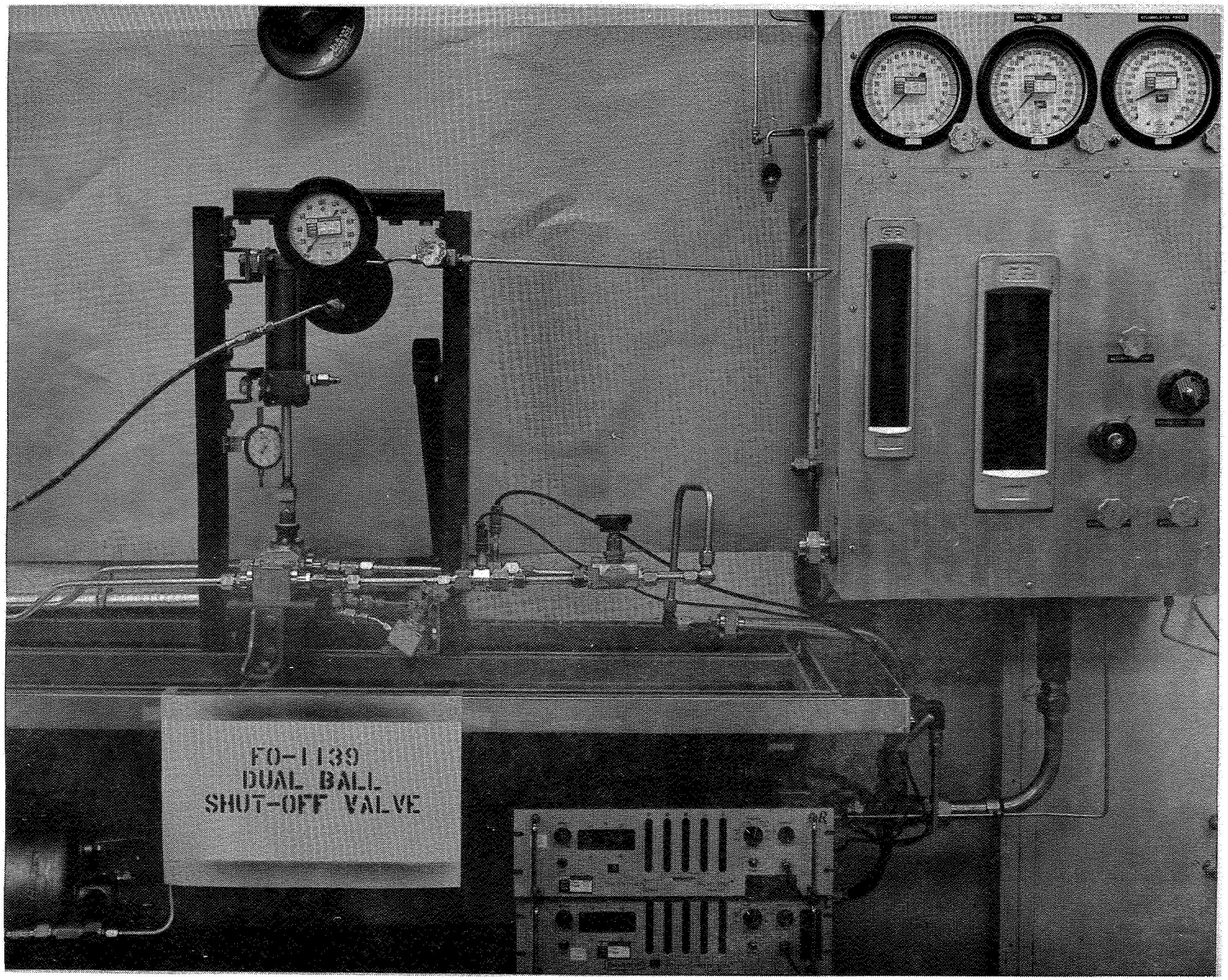


Figure 4-2. Functional Test Setup

SECTION V

LOW TEMPERATURE TEST

5.1 TEST REQUIREMENTS

5.1.1 A low temperature test shall be conducted on two test specimens to determine whether the environment caused degradation or deformation.

5.1.2 The rated low temperature shall be +25°F (+0, -4°F). The maximum temperature change rate shall be 1° per minute.

5.1.3 A functional test shall be conducted during this test after which the chamber shall be returned to ambient conditions.

5.1.4 A functional test and a visual inspection shall be conducted within one hour after returning the chamber to ambient conditions.

5.2 TEST PROCEDURE

5.2.1 Specimens number 1 and 2 were placed in a temperature chamber as shown in figures 4-1, 4-2 and 5-1, utilizing the equipment listed in table 4-1.

5.2.2 The chamber was controlled to the specified test conditions of +25°F (+0, -4°F) and a relative humidity of between 60 and 90 percent was maintained.

5.2.3 A functional test was conducted when the specimen temperature stabilized.

5.2.4 The chamber temperature was returned to ambient conditions upon completion of the functional test.

5.2.5 Each of the two specimens were visually inspected and functionally tested within 1 hour following the establishment of ambient conditions.

5.2.6 All test data were recorded.

5.3 TEST RESULTS

The specimens, number 1 and 2, successfully met the requirements of the low temperature test.

5.4 TEST DATA

The data presented in tables 5-1, 5-2, 5-3, and 5-4 were recorded during the low temperature test.

Table 5-1. Functional Test Data Obtained During Low Temperature Test

TEST DATA SHEET				Specimen No. 1		
Flow Direction	Test Media	Pressure (Psig)	Flow (Gpm)	Closing Force (Pounds)	Leakage	
					Int	Ext
Inlet	MIL-H-5606	1500	10	275	None	None
Outlet	MIL-H-5606	1500	10	275	None	None

Table 5-2. Functional Test Data Obtained After Low Temperature Test

TEST DATA SHEET				Specimen No. 1		
Flow Direction	Test Media	Pressure (Psig)	Flow (Gpm)	Closing Force (Pounds)	Leakage	
					Int	Ext
Inlet	MIL-H-5606	1500	10	255	None	None
Outlet	MIL-H-5606	1500	10	260	None	None

Table 5-3. Functional Test Data Obtained During Low Temperature Test

TEST DATA SHEET				Specimen No. 2		
Flow Direction	Test Media	Pressure (Psig)	Flow (Gpm)	Closing Force (Pounds)	Leakage	
					Int	Ext
Inlet	MIL-H-5606	1500	10	275	None	None
Outlet	MIL-H-5606	1500	10	265	None	None

Table 5-4. Functional Test Data Obtained After Low Temperature Test

TEST DATA SHEET				Specimen No. 2		
Flow Direction	Test Media	Pressure (Psig)	Flow (Gpm)	Closing Force (Pounds)	Leakage	
					Int	Ext
Inlet	MIL-H-5606	1500	10	270	None	None
Outlet	MIL-H-5606	1500	10	275	None	None

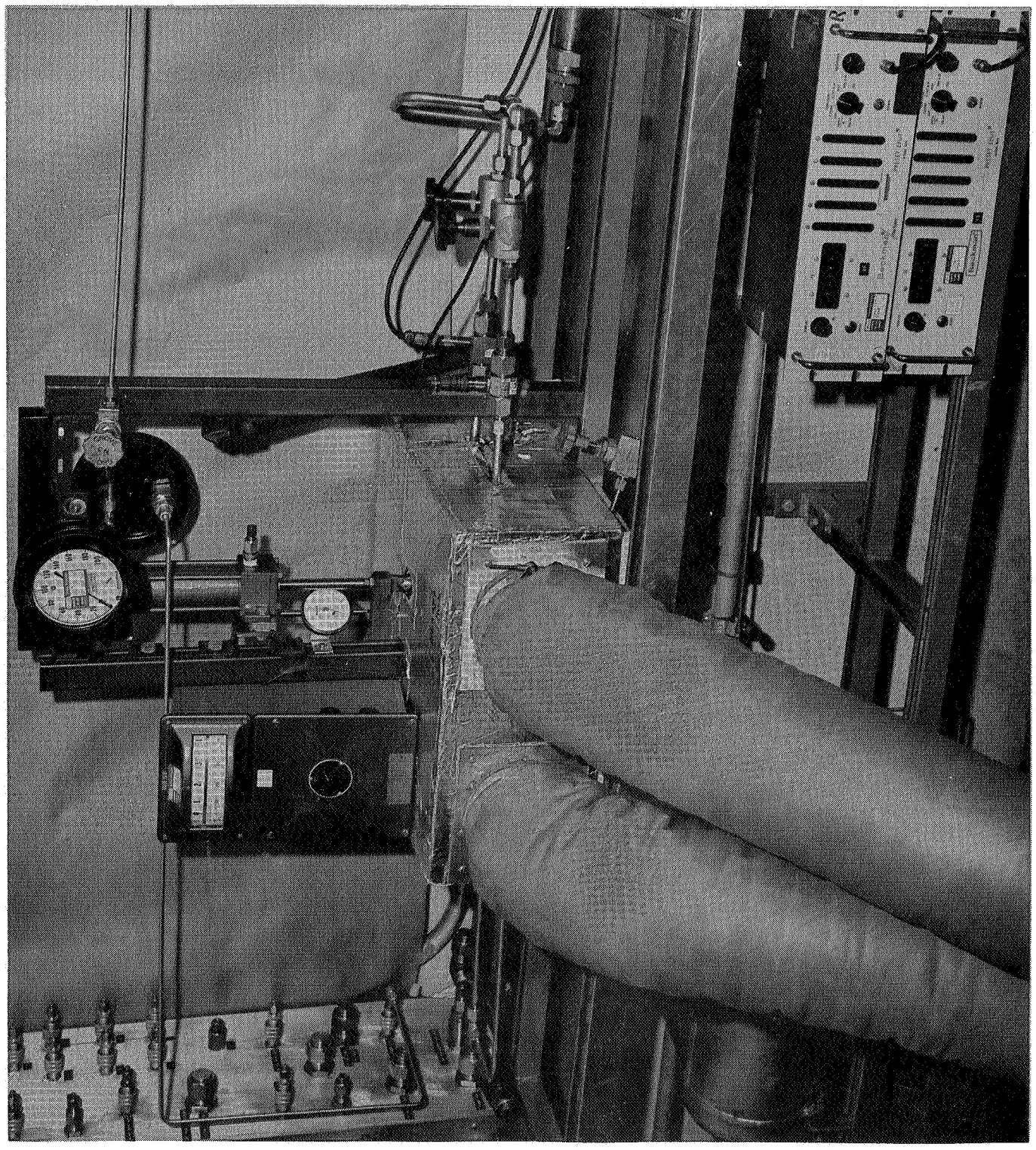


Figure 5-1. Low and High Temperature Test Setup

SECTION VI

HIGH TEMPERATURE TEST

6.1 TEST REQUIREMENTS

6.1.1 A high temperature test shall be conducted on two test specimens to determine whether the environment caused degradation or deformation.

6.1.2 The rated high temperature shall be 125°F (+4, -0°F). The maximum temperature change rate shall be 1° per minute.

6.1.3 A functional test shall be conducted during this test after which the chamber shall be returned to ambient conditions.

6.1.4 A functional test and a visual inspection shall be conducted within one hour after returning the chamber to ambient conditions.

6.2 TEST PROCEDURE

6.2.1 Specimens number 1 and 2 were placed in a temperature chamber as shown in figures 4-1, 4-2 and 5-1, utilizing the equipment listed in table 4-1.

6.2.2 The chamber was controlled to the specified test conditions of +125°F (+0, -4°F) and a relative humidity of between 60 and 90 percent was maintained.

6.2.3 A functional test was conducted when the specimen temperature stabilized.

6.2.4 The chamber temperature was returned to ambient conditions upon completion of the functional test.

6.2.5 Each of the two specimens were visually inspected and functionally tested within 1 hour following the establishment of ambient conditions.

6.2.6 All test data were recorded.

6.3 TEST RESULTS

The specimens, number 1 and 2, successfully met the requirements of the high temperature test.

6.4 TEST DATA

The data presented in tables 6-1, 6-2, 6-3, and 6-4 were recorded during the high temperature test.

Table 6-1. Functional Test Data Obtained During High Temperature Test

TEST DATA SHEET — Specimen No. 2						
Flow Direction	Test Media	Pressure (Psig)	Flow (Gpm)	Closing Force (Pounds)	Leakage	
					Int	Ext
Inlet	Mil-H-5606	1500	10	260	None	None
Outlet	Mil-H-5606	1500	10	255	None	None

Table 6-2, Functional Test Data Obtained After High Temperature Test

TEST DATA SHEET — Specimen No. 2						
Flow Direction	Test Media	Pressure (Psig)	Flow (Gpm)	Closing Force (Pounds)	Leakage	
					Int	Ext
Inlet	Mil-H-5606	1500	10	260	None	None
Outlet	Mil-H-5606	1500	10	252	None	None

Table 6-3. Functional Test Data Obtained During High Temperature Test

TEST DATA SHEET — Specimen No. 1						
Flow Direction	Test Media	Pressure (Psig)	Flow (Gpm)	Closing Force (Pounds)	Leakage	
					Int	Ext
Inlet	Mil-H-5606	1500	10	315	None	None
Outlet	Mil-H-5606	1500	10	302	None	None

Table 6-4. Functional Test Data Obtained After High Temperature Test

TEST DATA SHEET — Specimen No. 1						
Flow Direction	Test Media	Pressure (Psig)	Flow (Gpm)	Closing Force (Pounds)	Leakage	
					Int	Ext
Inlet	Mil-H-5606	1500	10	322	None	None
Outlet	Mil-H-5606	1500	10	320	None	None

SECTION VII

VIBRATION TEST

7.1 TEST REQUIREMENTS

7.1.1 A vibration test shall be conducted on two test specimens in accordance with section 9 of KSC-STD-164(D), to the levels specified in GP-320, zone 3.2.1.

7.1.2 Each of the two specimens shall be subjected to sinusoidal and random vibration along three mutually perpendicular axes. The specimens shall be actuated in the final seconds of vibration in the Y axis.

7.1.3 A functional test shall be conducted on the specimens upon completion of the sinusoidal and random vibration along each axis.

7.2 TEST PROCEDURE

7.2.1 Speciments number 2 and 3 were installed on a vibration exciter as shown in figure 7-1 to permit vibration to be applied along the X axis (see figure 7-2).

7.2.3 Hand valve 4 was opened and using hand pump 5 the specimens were pressurized to 1500 psig as indicated by pressure gage 3. The specimens were subjected to sinusoidal and random excitation.

7.2.4 Sinusoidal Sweep

7.2.4.1 Specimens number 1 and 2 were subjected to sinusoidal vibration by scanning the frequency range logarithmically from 10 to 2000 cps and from 2000 to 10 cps for a test period of 20 minutes (10 minutes up and 10 minutes back). The vibration levels were as follows:

10 to 18 cps @ 0.3 Inches D.A.
18 to 48 cps @ 5.0g Peak
48 to 90 cps @ 0.05 Inches D.A.
90 to 2000 cps @ 20.0g Peak

7.2.4.2 A functional test was conducted on the specimens upon completion of the sinusoidal scan.

7.2.5 Random Excitation

7.2.5.1 Specimens number 1 and 2 were subjected to random vibration over the frequency range of 10 to 2000 cps for a period of five minutes. The vibration levels were as follows:

10 to 1000 cps @ $0.35g^2$/cps
1000 to 2000 cps @ -6 db/octave

7.2.5.2 A functional test was conducted on the specimens upon completion of random vibration.

7.2.6 Each of the two specimens was subjected to vibration along each of the remaining two mutually perpendicular axes in accordance with subparagraphs 7.2.4 and 7.2.5. Each specimen was actuated during the final seconds of vibration in the Y axis.

7.3 TEST RESULTS

The specimens, number 2 and 3, successfully withstood vibration testing in the three mutually perpendicular axes.

7.4 TEST DATA

7.4.1 Typical control accelerometer plots, as recorded during the test, are presented in figures 7-5 and 7-6.

7.4.2 The functional test data, recorded during and after the vibration tests, are presented in tables 7-2 through 7-15.

Table 7-1. Vibration Test Equipment List

Item No.	Item	Manufacturer	Model Part No.	Serial No.	Remarks
1	Test Specimen	Flodyne	5C151	4 and 9	Dual Ball Valve
2	Vibration Exciter System	MB Electronics	C-210		
3	Pressure Gage	Marsh Instrument	NA	95-1184B	0 to 3000 psig Cal. date 11-28-67
4	Hand Valve	Robbins Aviation	SSKG-250-4T	NA	$\frac{1}{4}$-inch
5	Hand Pump	Wm. S. Pine Inc.	160-3	NA	0 to 5000 psig
6	Cylinder	Parker-Hannfin	CC-2AS14C	F-95986	2-inch bore
7	Gage	Ashcroft Corp.	NA	95-1403	0 to 200 psig Cal. date 10-14-67
8	Regulator	Oxweld Inc.	R-89	NA	0 to 3000 psig
9	GN_2 Supply	Air Products	NA	NA	0 to 2000 psig

Table 7-2. Post Sinusoidal Sweep "X" Axis Functional Test Data

TEST DATA SHEET				Specimen No. 2		
Flow Direction	Test Media	Pressure (Psig)	Flow (Gpm)	Closing Force (Pounds)	Leakage Int	Leakage Ext
Inlet	Mil-H-5606	1500	10	288	None	None
Outlet	Mil-H-5606	1500	10	260	None	None

Table 7-3. Post Random Vibration "X" Axis Functional Test Data

TEST DATA SHEET				Specimen No. 2		
Flow Direction	Test Media	Pressure (Psig)	Flow (Gpm)	Closing Force (Pounds)	Leakage Int	Leakage Ext
Inlet	Mil-H-5606	1500	10	285	None	None
Outlet	Mil-H-5606	1500	10	290	None	None

Table 7-4. Post Sinusoidal Sweep "Z" Axis Functional Test Data

TEST DATA SHEET				Specimen No. 2		
Flow Direction	Test Media	Pressure (Psig)	Flow (Gpm)	Closing Force (Pounds)	Leakage Int	Leakage Ext
Inlet	Mil-H-5606	1500	10	288	None	None
Outlet	Mil-H-5606	1500	10	290	None	None

Table 7-5. Post Random Vibration "Z" Axis Functional Test Data

TEST DATA SHEET				Specimen No. 2		
Flow Direction	Test Media	Pressure (Psig)	Flow (Gpm)	Closing Force (Pounds)	Leakage Int	Leakage Ext
Inlet	Mil-H-5606	1500	10	290	None	None
Outlet	Mil-H-5606	1500	10	295	None	None

Table 7-6. Post Sinusoidal Sweep "Y" Axis Functional Test Data

Specimen No. 2

TEST DATA SHEET

Flow Direction	Test Media	Pressure (Psig)	Flow (Gpm)	Closing Force (Pounds)	Leakage	
					Int	Ext
Inlet	Mil-H-5606	1500	10	295	None	None
Outlet	Mil-H-5606	1500	10	300	None	None

Table 7-7. Post Random Vibration "Y" Axis Functional Test Data

Specimen No. 2

TEST DATA SHEET

Flow Direction	Test Media	Pressure (Psig)	Flow (Gpm)	Closing Force (Pounds)	Leakage	
					Int	Ext
Inlet	Mil-H-5606	1500	10	297	None	None
Outlet	Mil-H-5606	1500	10	302	None	None

Table 7-8. Data Obtained During Random Vibration "Y" Axis.

Specimen No. 2

TEST DATA SHEET

Flow Direction	Test Media	Pressure (Psig)	Flow (Gpm)	Closing Force (Pounds)	Leakage	
					Int	Ext
Inlet	Mil-H-5606	1500	0	297	None	None

Table 7-9. Post Sinusoidal Sweep "X" Axis Functional Test Data

TEST DATA SHEET — Specimen No. 3						
Flow Direction	Test Media	Pressure (Psig)	Flow (Gpm)	Closing Force (Pounds)	Leakage	
					Int	Ext
Inlet	Mil-H-5606	1500	10	290	None	None
Outlet	Mil-H-5606	1500	10	290	None	None

Table 7-10. Post Random Vibration "X" Axis Functional Test Data

TEST DATA SHEET — Specimen No. 3						
Flow Direction	Test Media	Pressure (Psig)	Flow (Gpm)	Closing Force (Pounds)	Leakage	
					Int	Ext
Inlet	Mil-H-5606	1500	10	302	None	None
Outlet	Mil-H-5606	1500	10	300	None	None

Table 7-11. Post Sinusoidal Sweep "Z" Axis Functional Test Data

TEST DATA SHEET — Specimen No. 3						
Flow Direction	Test Media	Pressure (Psig)	Flow (Gpm)	Closing Force (Pounds)	Leakage	
					Int	Ext
Inlet	Mil-H-5606	1500	10	302	None	None
Outlet	Mil-H-5606	1500	10	300	None	None

Table 7-12. Post Random Vibration "Z" Axis Functional Test Data

TEST DATA SHEET — Specimen No. 3						
Flow Direction	Test Media	Pressure (Psig)	Flow (Gpm)	Closing Force (Pounds)	Leakage	
					Int	Ext
Inlet	Mil-H-5606	1500	10	297	None	None
Outlet	Mil-H-5606	1500	10	302	None	None

Table 7-13. Post Sinusoidal Sweep "Y" Axis Functional Test Data

Specimen No. 3

TEST DATA SHEET

Flow Direction	Test Media	Pressure (Psig)	Flow (Gpm)	Closing Force (Pounds)	Leakage	
					Int	Ext
Inlet	Mil-H-5606	1500	10	300	None	None
Outlet	Mil-H-5606	1500	10	302	None	None

Table 7-14. Post Random Vibration "Y" Axis Functional Test Data

Specimen No. 3

TEST DATA SHEET

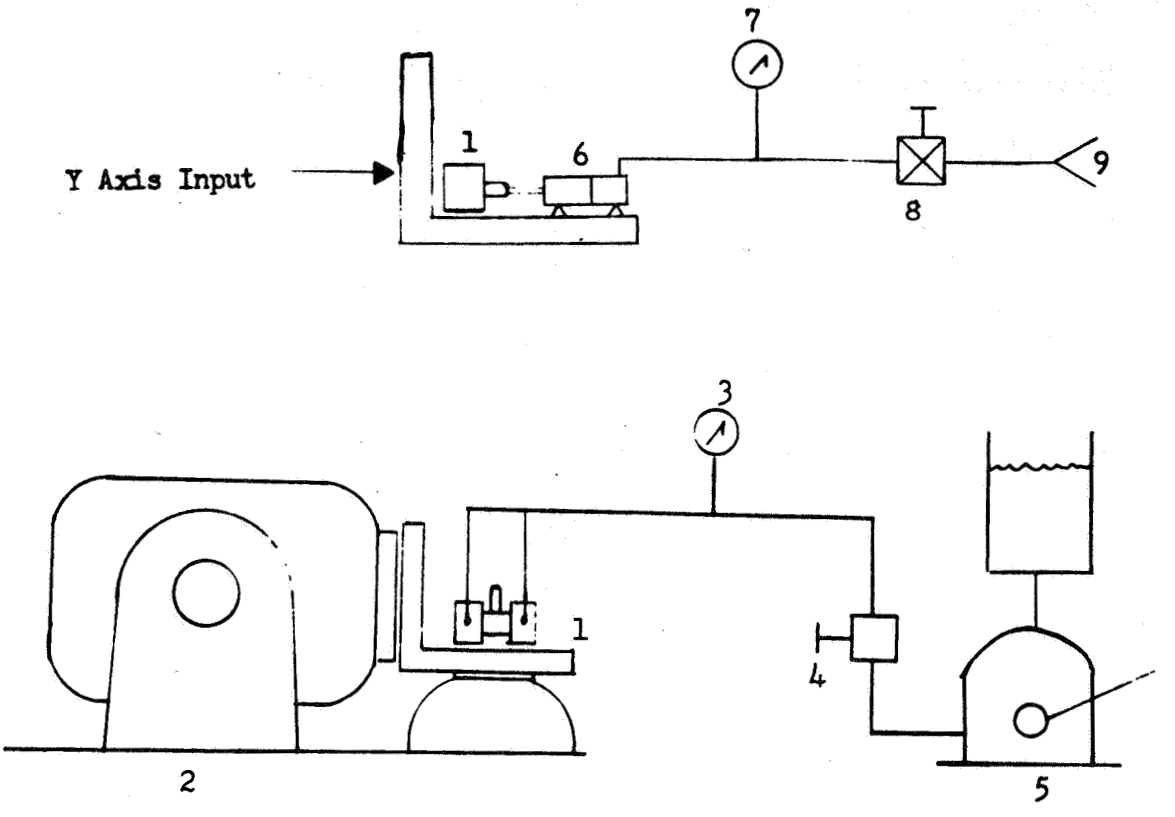
Flow Direction	Test Media	Pressure (Psig)	Flow (Gpm)	Closing Force (Pounds)	Leakage	
					Int	Ext
Inlet	Mil-H-5606	1500	10	302	None	None
Outlet	Mil-H-5606	1500	10	308	None	None

Table 7-15. Data Obtained During Random Vibration "Y" Axis

Specimen No. 3

TEST DATA SHEET

Flow Direction	Test Media	Pressure (Psig)	Flow (Gpm)	Closing Force (Pounds)	Leakage	
					Int	Ext
Inlet	Mil-H-5606	1500	0	302	None	None



Note: All lines ¼-inch.

Refer to table 7-1 for item identification.

Figure 7-1. Vibration Test Schematic (X and Y Axis)

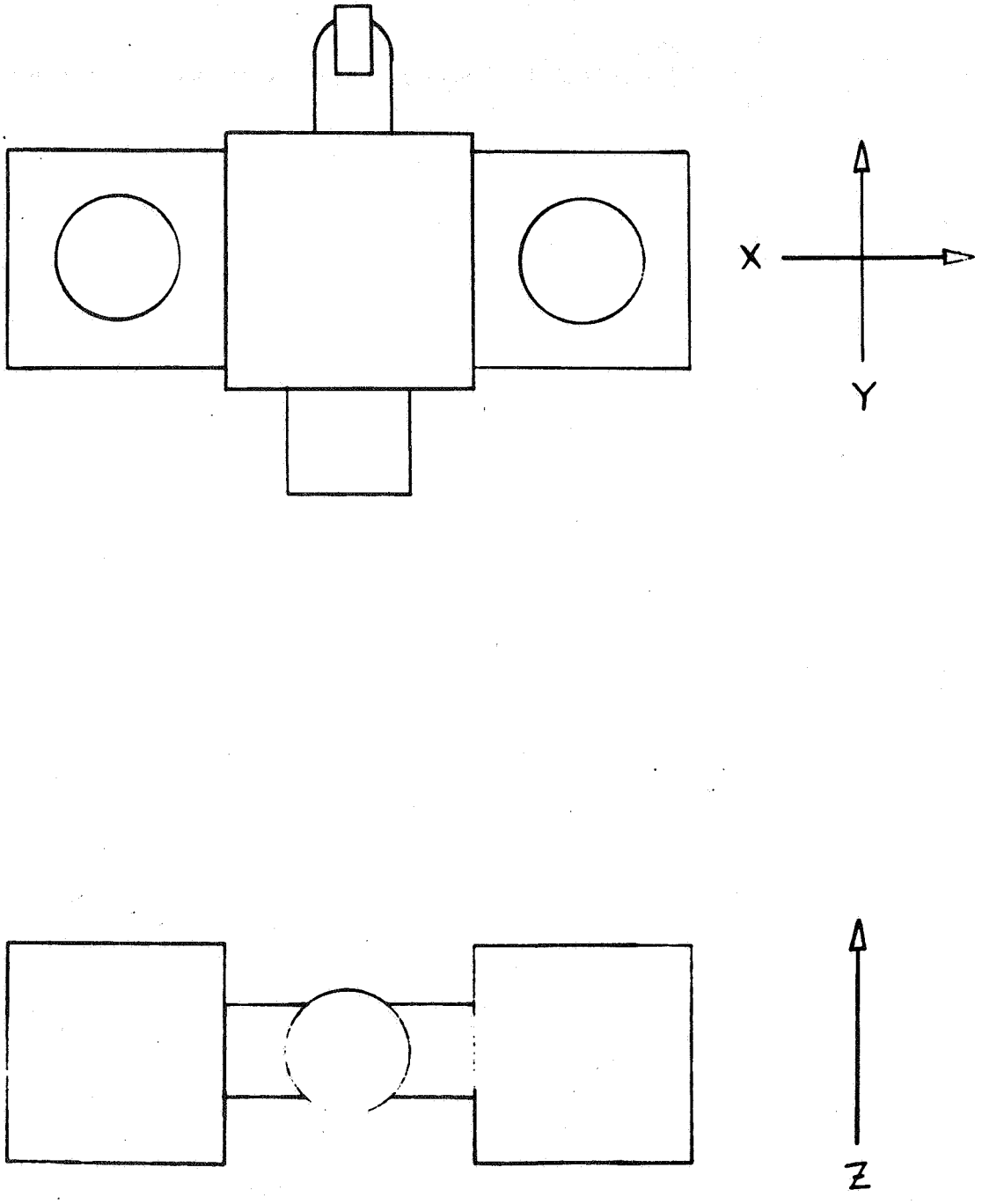


Figure 7-2. Vibration Axes

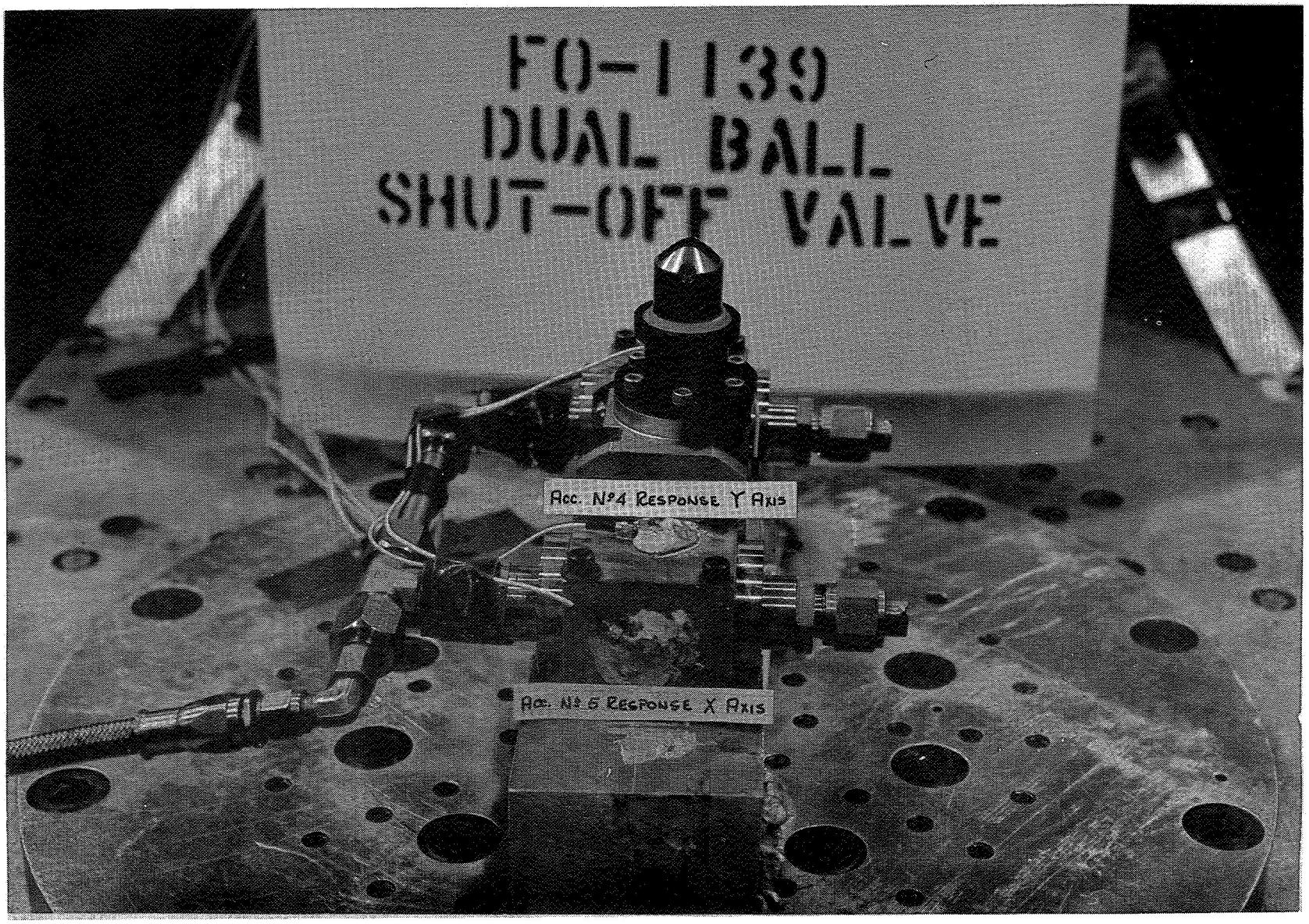


Figure 7-3. Vibration Setup For X and Z Axes

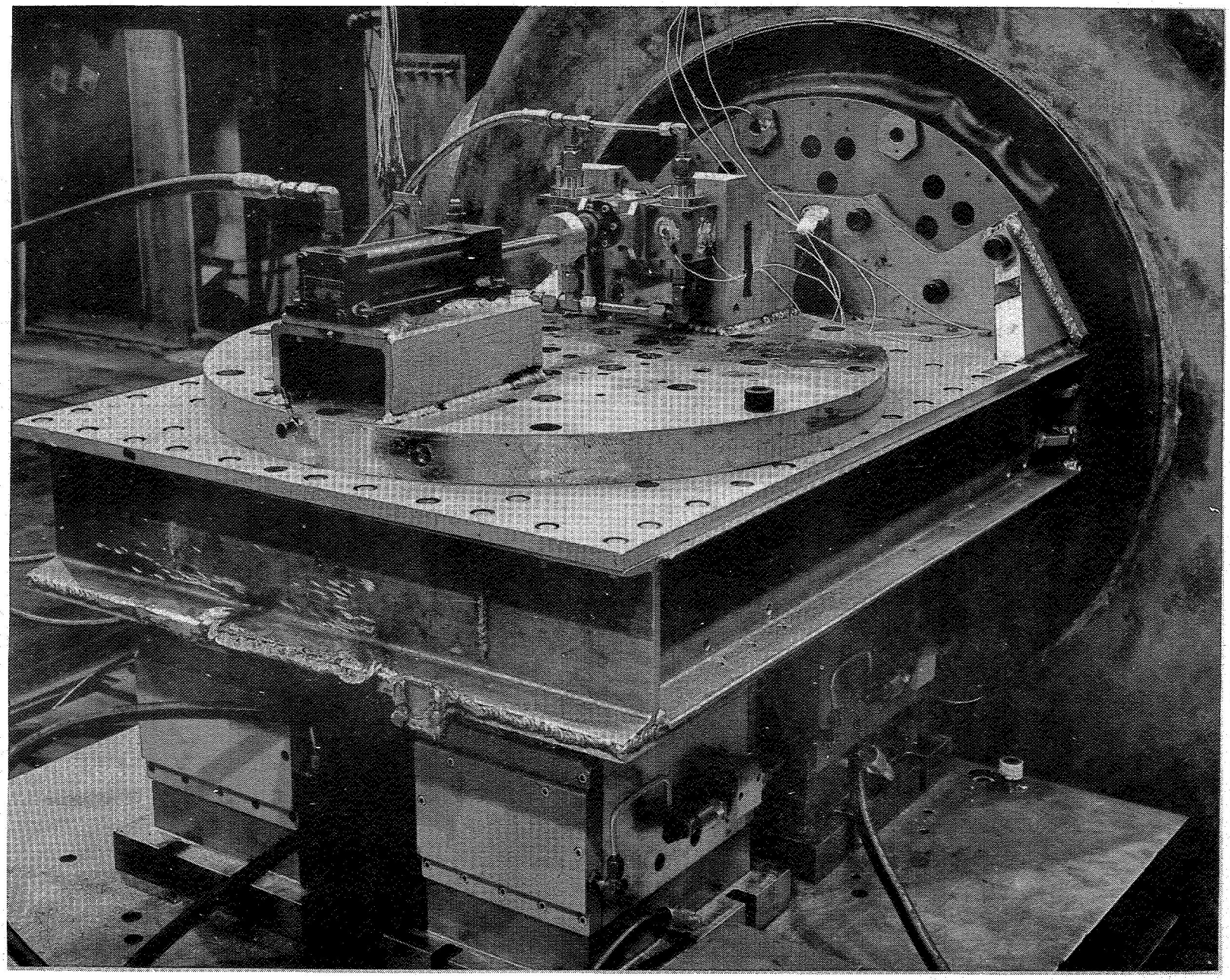


Figure 7-4. Vibration Setup For Y Axis

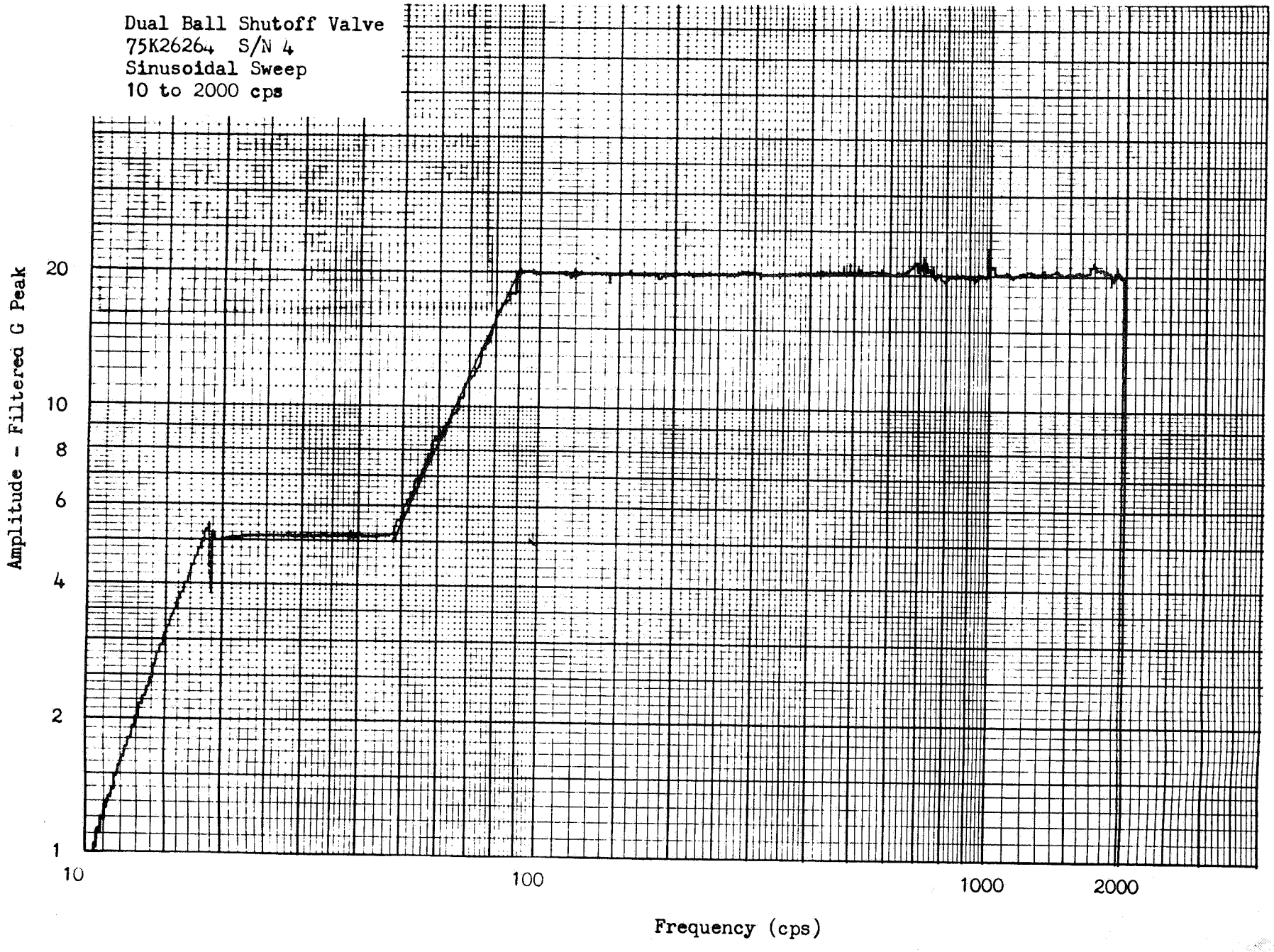


Figure 7-5. Typical Sinusoidal Vibration Plot - Control Accelerometer

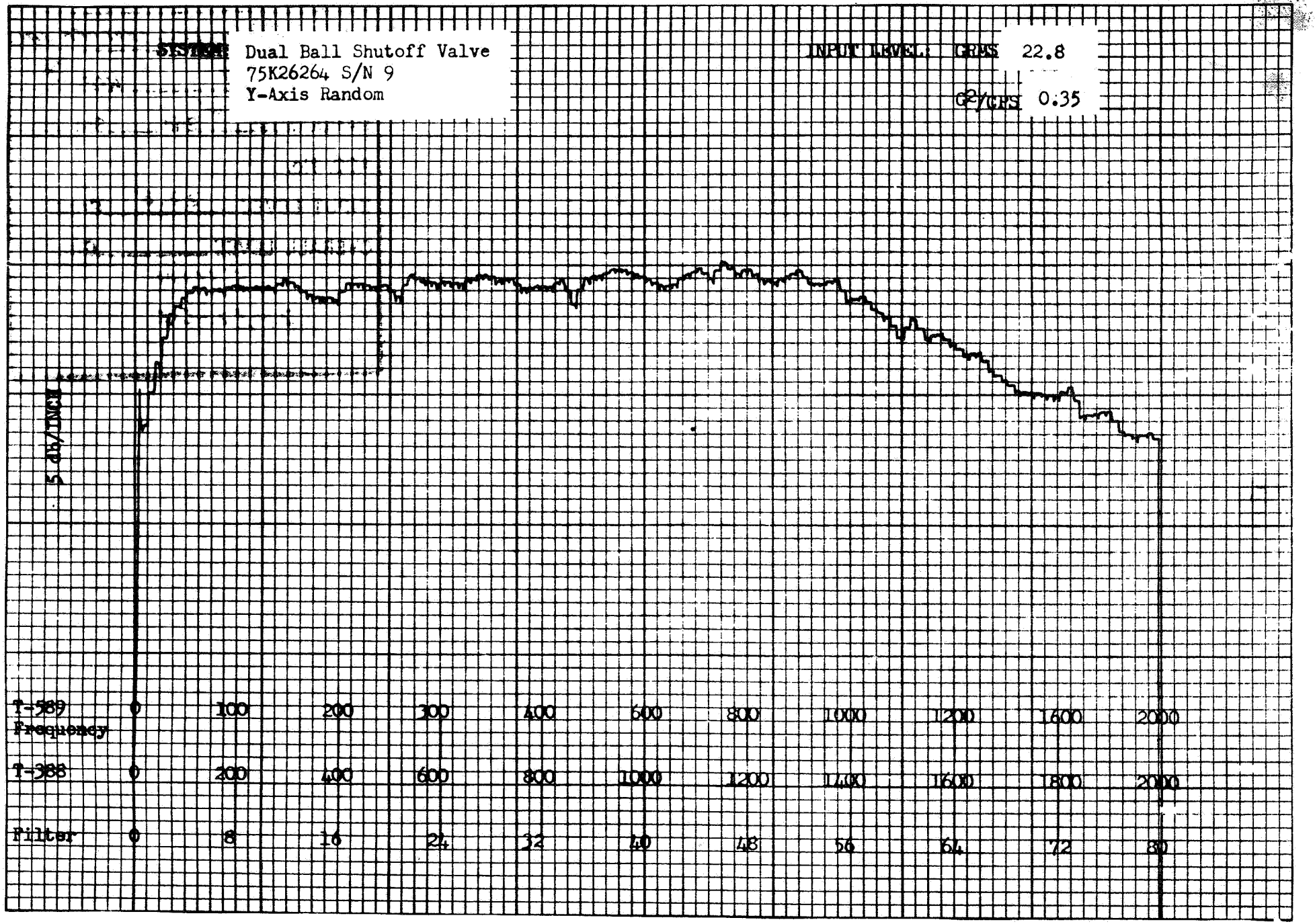


Figure 7-6. Typical Random Vibration Plot - Control Accelerometer

SECTION VIII

SALT FOG TEST

8.1 TEST REQUIREMENTS

8.1.1 A salt fog test shall be conducted on two specimens to determine the resistance of the specimens to a salt atmosphere.

8.1.2 The salt fog test shall be performed in accordance with KSC-STD-164(D), section 17.

8.1.3 Each of the two specimens shall be exposed to the salt fog for 240 hours (± 2 hours). The inlet and outlet ports of the specimens shall be capped during exposure to the salt atmosphere.

8.1.4 A functional test as specified in section IV shall be conducted upon completion of the salt fog test.

8.2 TEST PROCEDURE

8.2.1 Prior to the salt fog test, specimens number 2 and 3, each was visually inspected for corrosion, dirt, and oily films. All unnecessary oil films and dirt particles were removed, and spots of corrosion were noted.

8.2.2 With the inlet and outlet ports capped, each specimen was placed in the salt fog chamber as shown in figure 8-1 and listed in table 8-1. The chamber was adjusted to a temperature of 95°F so that the clean fog-collecting receptacle in the exposure zone could collect from 0.5 to 3 milliliters of solution per hour for 80 square centimeters of horizontal collecting area. This condition was maintained for 240 hours.

8.2.3 At the end of the 240-hour period, the specimens were removed from the chamber and allowed to return to room ambient conditions.

8.2.4 One hour after returning the specimens to room ambient conditions, a functional test was performed. All test data were recorded.

8.3 TEST DATA

Functional test data, recorded after the salt fog test, are presented in tables 8-2 and 8-3.

Table 8-1. Salt Fog Test Equipment List

Item No.	Item	Manufacturer	Model Part No.	Serial No.	Remarks
1	Test Specimen	Flodyne, Inc.	5C151	4 and 9	Dual Ball Valve
2	Salt Fog Chamber	Industrial Filter and Pump Mfg. Co.	NA	53832	As Specified in KSC-STD-164(D)

Table 8-2. Post Salt Fog Test Functional Test Data

Specimen No. 2

TEST DATA SHEET

Flow Direction	Test Media	Pressure (Psig)	Flow (Gpm)	Closing Force (Pounds)	Leakage	
					Int	Ext
Inlet	Mil-H-5606	1500	10	302	None	None
Outlet	Mil-H-5606	1500	10	308	None	None

Table 8-3. Post Salt Fog Test Functional Test Data

Specimen No. 3

TEST DATA SHEET

Flow Direction	Test Media	Pressure (Psig)	Flow (Gpm)	Closing Force (Pounds)	Leakage	
					Int	Ext
Inlet	Mil-H-5606	1500	10	308	None	None
Outlet	Mil-H-5606	1500	10	316	None	None

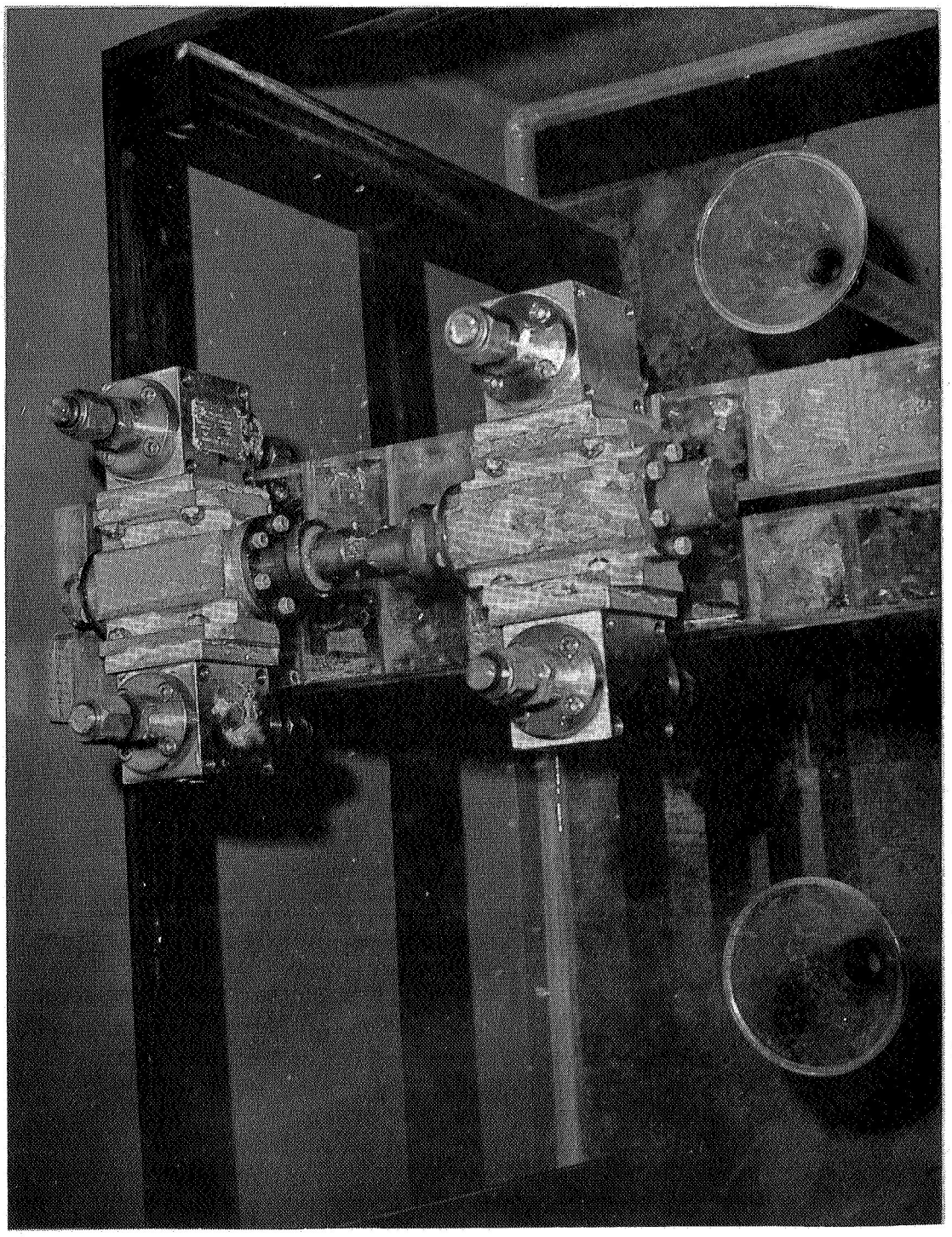


Figure 8-1. Salt Fog Test Setup

SECTION IX

LIFE CYCLE TEST

9.1 TEST REQUIREMENTS

9.1.1 A cycle test shall be conducted on the test specimens using MIL-H-5606 hydraulic fluid as the operating medium. Each specimen shall be cycled from full open to full closed position for 5000 cycles. Full open to full closed to full open shall constitute one cycle.

9.1.2 A functional test as specified in section IV shall be conducted after 50, 100, 500, 1000, 2000, 3000, 4000, 5000 cycles.

9.2 TEST PROCEDURE

9.2.1 Each specimen was installed in the life cycle setup as shown in figures 4-1, 9-1 and 9-2, utilizing the equipment listed in table 4-1.

9.2.2 It was determined that all connections were tight, all gages were installed and working properly, and all valves were closed.

9.2.3 Pump 2 was started and the pump discharge pressure was adjusted to 1500 psig as indicated by gage 3.

9.2.4 Hand valves 6 and 7 were adjusted until a hydraulic flow of 10 gpm was indicated on flowmeters 4 and 5.

9.2.5 Regulator 10, solenoid valves 9 and 21 and hand valves 11 and 20 were opened.

9.2.6 Hand valves 11 and 20 and regulator 10 were adjusted until a specimen closing rate of zero to 80 percent within 3.5 seconds and 80 percent to 100 percent within 0.5 seconds was attained.

9.2.7 Cycle timer 19 was adjusted until the proper sequencing of solenoid valves 9 and 21 was accomplished.

9.2.8 The rotation of the specimen from full open to full closed to full open constitutes one cycle.

9.2.9 5000 cycles were performed on specimen 1 with functional tests conducted after 50, 100, 500, 1000, 2000, 3000, 4000 and 5000 cycles. 2500 cycles were performed on specimen number 2 and 3 with functional tests conducted after 50, 100, 500, 1000, 1500, 2000 and 2500 cycles.

9.2.10 During the cycle tests, pressure at the specimen inlet was recorded by using transducers 22 and 23.

9.3 TEST RESULTS

The specimens successfully withstood the cycle test.

9.4 TEST DATA

9.4.1 Functional test data, recorded during the test, are presented in tables 9-1 through 9-23.

9.4.2 A typical surge waveform, recorded at specimen inlet, is presented in figure 9-3.

Table 9-1. Pre-Cycle Functional Test Data

TEST DATA SHEET Specimen No. 1						
Flow Direction	Test Media	Pressure (Psig)	Flow (Gpm)	Closing Force (Pounds)	Leakage	
					Int	Ext
Inlet	Mil-H-5606	1500	10	265	None	None
Outlet	Mil-H-5606	1500	10	270	None	None

Table 9-2. Post-50 Cycle Functional Test Data

TEST DATA SHEET Specimen No. 1						
Flow Direction	Test Media	Pressure (Psig)	Flow (Gpm)	Closing Force (Pounds)	Leakage	
					Int	Ext
Inlet	Mil-H-5606	1500	10	270	None	None
Outlet	Mil-H-5606	1500	10	275	None	None

Table 9-3. Post-100 Cycles Functional Test Data

TEST DATA SHEET Specimen No. 1						
Flow Direction	Test Media	Pressure (Psig)	Flow (Gpm)	Closing Force (Pounds)	Leakage	
					Int	Ext
Inlet	Mil-H-5606	1500	10	275	None	None
Outlet	Mil-H-5606	1500	10	275	None	None

Table 9-4. Post-500 Cycle Functional Test Data

TEST DATA SHEET Specimen No. 1						
Flow Direction	Test Media	Pressure (Psig)	Flow (Gpm)	Closing Force (Pounds)	Leakage	
					Int	Ext
Inlet	Mil-H-5606	1500	10	270	None	None
Outlet	Mil-H-5606	1500	10	275	None	None

Table 9-5. Post-1000 Cycles Functional Test Data

TEST DATA SHEET — Specimen No. 1						
Flow Direction	Test Media	Pressure (Psig)	Flow (Gpm)	Closing Force (Pounds)	Leakage	
					Int	Ext
Inlet	Mil-H-5606	1500	10	280	None	None
Outlet	Mil-H-5606	1500	10	275	None	None

Table 9-6. Post-2000 Cycles Functional Test Data

TEST DATA SHEET — Specimen No. 1						
Flow Direction	Test Media	Pressure (Psig)	Flow (Gpm)	Closing Force (Pounds)	Leakage	
					Int	Ext
Inlet	Mil-H-5606	1500	10	290	None	None
Outlet	Mil-H-5606	1500	10	285	None	None

Table 9-7. Post-3000 Cycles Functional Test Data

TEST DATA SHEET — Specimen No. 1						
Flow Direction	Test Media	Pressure (Psig)	Flow (Gpm)	Closing Force (Pounds)	Leakage	
					Int	Ext
Inlet	Mil-H-5606	1500	10	290	None	None
Outlet	Mil-H-5606	1500	10	285	None	None

Table 9-8. Post-4000 Cycles Functional Test Data

TEST DATA SHEET — Specimen No. 1						
Flow Direction	Test Media	Pressure (Psig)	Flow (Gpm)	Closing Force (Pounds)	Leakage	
					Int	Ext
Inlet	Mil-H-5606	1500	10	325	None	None
Outlet	Mil-H-5606	1500	10	322	None	None

Table 9-9. Post-5000 Cycles Functional Test Data

TEST DATA SHEET — Specimen No. 1						
Flow Direction	Test Media	Pressure (Psig)	Flow (Gpm)	Closing Force (Pounds)	Leakage Int	Leakage Ext
Inlet	Mil-H-5606	1500	10	330	None	None
Outlet	Mil-H-5606	1500	10	325	None	None

Table 9-10. Post-50 Cycle Functional Test Data

TEST DATA SHEET — Specimen No. 2						
Flow Direction	Test Media	Pressure (Psig)	Flow (Gpm)	Closing Force (Pounds)	Leakage Int	Leakage Ext
Inlet	Mil-H-5606	1500	10	250	None	None
Outlet	Mil-H-5606	1500	.10	252	None	None

Table 9-11. Post-100 Cycles Functional Test Data

TEST DATA SHEET — Specimen No. 2						
Flow Direction	Test Media	Pressure (Psig)	Flow (Gpm)	Closing Force (Pounds)	Leakage Int	Leakage Ext
Inlet	Mil-H-5606	1500	.10	252	None	None
Outlet	Mil-H-5606	1500	10	258	None	None

Table 9-12. Post-500 Cycles Functional Test Data

TEST DATA SHEET — Specimen No. 2						
Flow Direction	Test Media	Pressure (Psig)	Flow (Gpm)	Closing Force (Pounds)	Leakage Int	Leakage Ext
Inlet	Mil-H-5606	1500	10	255	None	None
Outlet	Mil-H-5606	1500	10	260	None	None

Table 9-13. Post-1000 Cycles Functional Test Data

TEST DATA SHEET — Specimen No. 2						
Flow Direction	Test Media	Pressure (Psig)	Flow (Gpm)	Closing Force (Pounds)	Leakage	
					Int	Ext
Inlet	Mil-H-5606	1500	10	258	None	None
Outlet	Mil-H-5606	1500	10	260	None	None

Table 9-14. Post-1500 Cycles Functional Test Data

TEST DATA SHEET — Specimen No. 2						
Flow Direction	Test Media	Pressure (Psig)	Flow (Gpm)	Closing Force (Pounds)	Leakage	
					Int	Ext
Inlet	Mil-H-5606	1500	10	260	None	None
Outlet	Mil-H-5606	1500	10	265	None	None

Table 9-15. Post-2000 Cycles Functional Test Data

TEST DATA SHEET — Specimen No. 2						
Flow Direction	Test Media	Pressure (Psig)	Flow (Gpm)	Closing Force (Pounds)	Leakage	
					Int	Ext
Inlet	Mil-H-5606	1500	10	275	None	None
Outlet	Mil-H-5606	1500	10	275	None	None

Table 9-16. Post-2500 Cycles Functional Test Data

TEST DATA SHEET — Specimen No. 2						
Flow Direction	Test Media	Pressure (Psig)	Flow (Gpm)	Closing Force (Pounds)	Leakage	
					Int	Ext
Inlet	Mil-H-5606	1500	10	275	None	None
Outlet	Mil-H-5606	1500	10	280	None	None

Table 9-17. Post-50 Cycle Functional Test Data

TEST DATA SHEET				Specimen No. 3		
Flow Direction	Test Media	Pressure (Psig)	Flow (Gpm)	Closing Force (Pounds)	Leakage Int	Leakage Ext
Inlet	Mil-H-5606	1500	10	280	None	None
Outlet	Mil-H-5606	1500	10	285	None	None

Table 9-18. Post-100 Cycles Functional Test Data

TEST DATA SHEET				Specimen No. 3		
Flow Direction	Test Media	Pressure (Psig)	Flow (Gpm)	Closing Force (Pounds)	Leakage Int	Leakage Ext
Inlet	Mil-H-5606	1500	10	280	None	None
Outlet	Mil-H-5606	1500	10	282	None	None

Table 9-19. Post-500 Cycles Functional Test Data

TEST DATA SHEET				Specimen No. 3		
Flow Direction	Test Media	Pressure (Psig)	Flow (Gpm)	Closing Force (Pounds)	Leakage Int	Leakage Ext
Inlet	Mil-H-5606	1500	10	282	None	None
Outlet	Mil-H-5606	1500	10	285	None	None

Table 9-20. Post-1000 Cycles Functional Test Data

TEST DATA SHEET				Specimen No. 3		
Flow Direction	Test Media	Pressure (Psig)	Flow (Gpm)	Closing Force (Pounds)	Leakage Int	Leakage Ext
Inlet	Mil-H-5606	1500	10	280	None	None
Outlet	Mil-H-5606	1500	10	285	None	None

Table 9-21. Post-1500 Cycles Functional Test Data

Specimen No. 3

TEST DATA SHEET

Flow Direction	Test Media	Pressure (Psig)	Flow (Gpm)	Closing Force (Pounds)	Leakage	
					Int	Ext
Inlet	Mil-H-5606	1500	10	285	None	None
Outlet	Mil-H-5606	1500	10	285	None	None

Table 9-22. Post-2000 Cycles Functional Test Data

Specimen No. 3

TEST DATA SHEET

Flow Direction	Test Media	Pressure (Psig)	Flow (Gpm)	Closing Force (Pounds)	Leakage	
					Int	Ext
Inlet	Mil-H-5606	1500	10	285	None	None
Outlet	Mil-H-5606	1500	10	285	None	None

Table 9-23. Post-2500 Cycles Functional Test Data

Specimen No. 3

TEST DATA SHEET

Flow Direction	Test Media	Pressure (Psig)	Flow (Gpm)	Closing Force (Pounds)	Leakage	
					Int	Ext
Inlet	Mil-H-5606	1500	10	288	None	None
Outlet	Mil-H-5606	1500	10	288	None	None

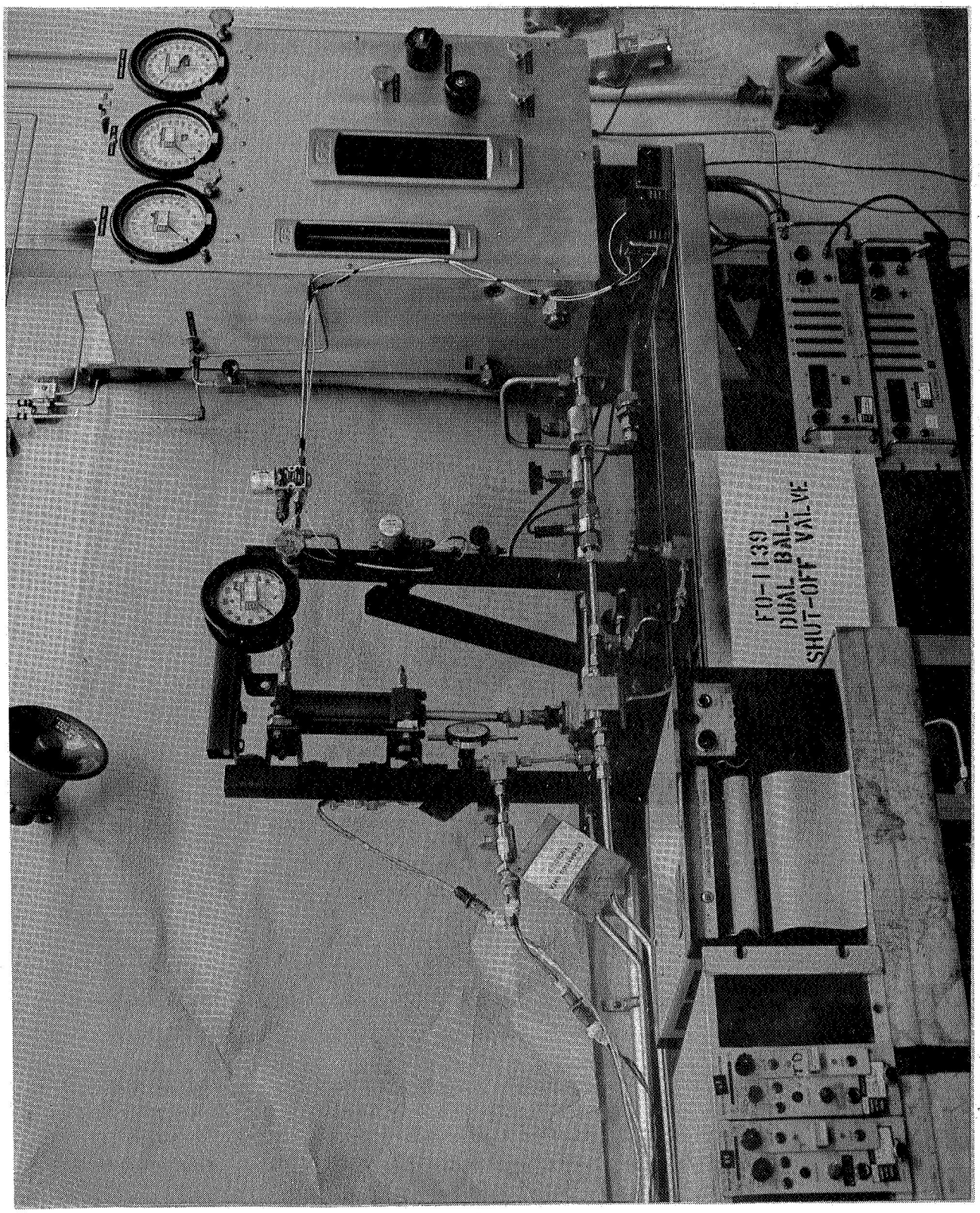


Figure 9-1. Life Cycle Test Setup

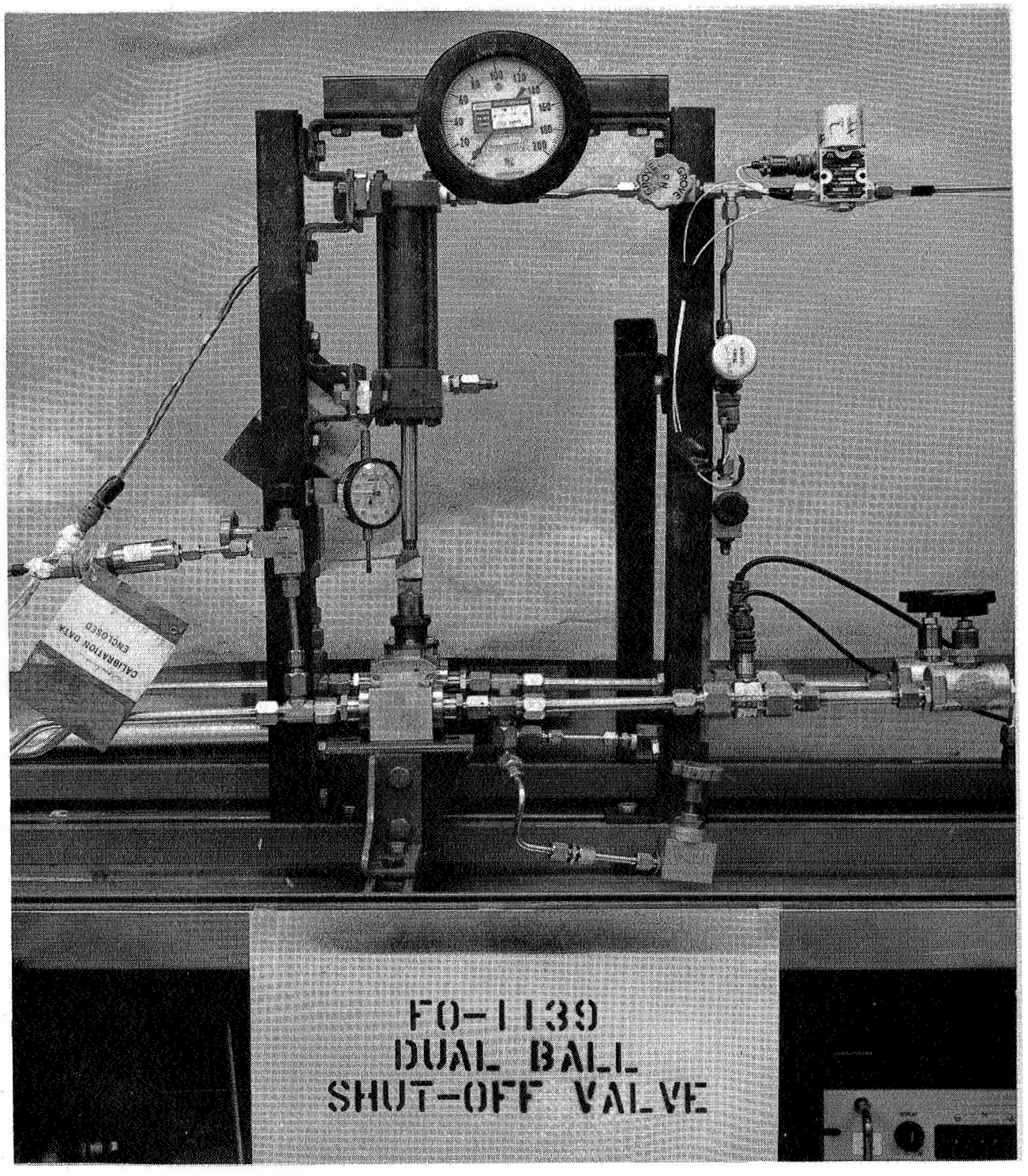


Figure 9-2. Life Cycle Test Setup

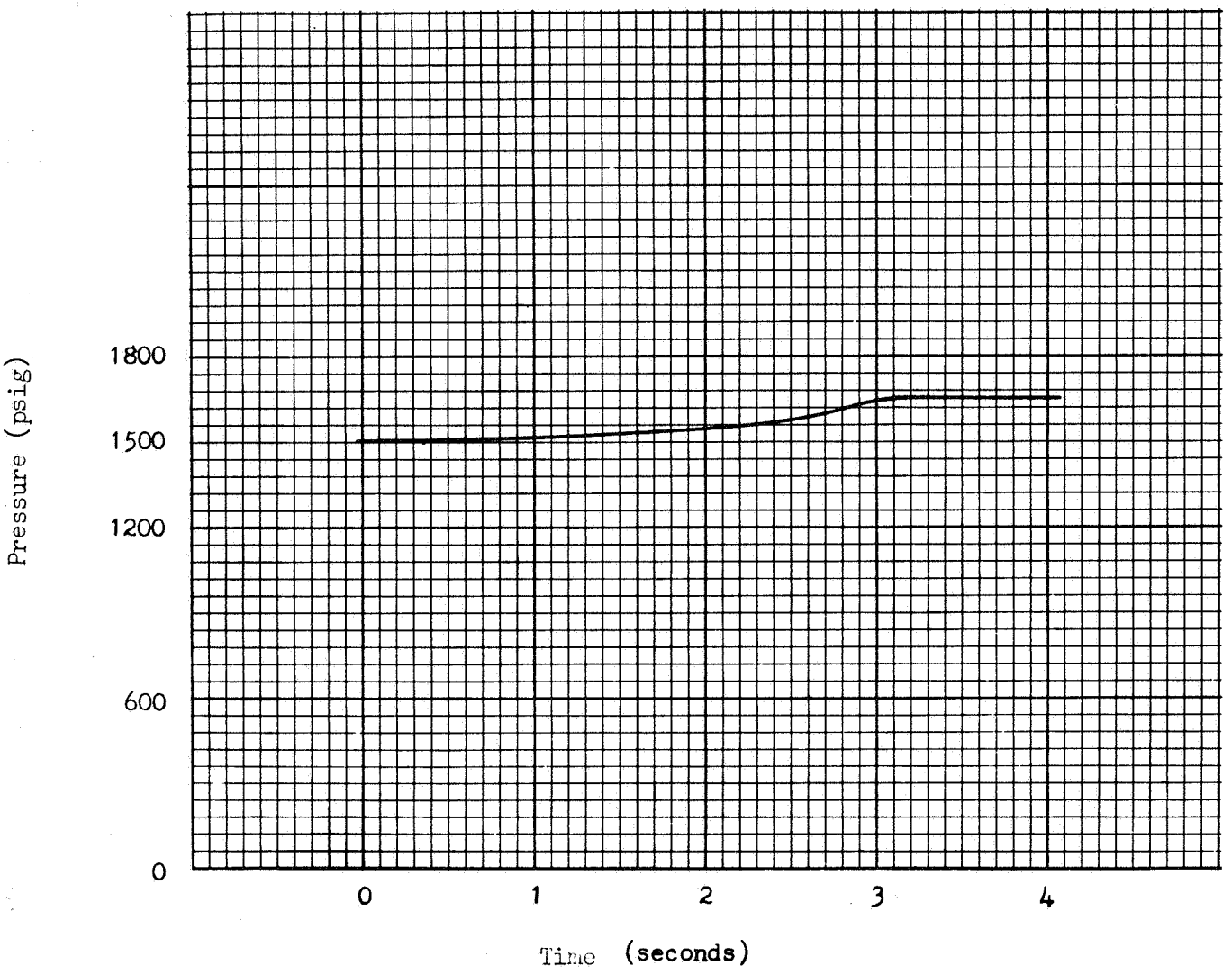


Figure 9-3. Typical Closing Cycle Pressure Recording At Specimen Inlet

SECTION X

REPEATABILITY TEST

10.1 TEST REQUIREMENTS

10.1.1 A repeatability test shall be conducted on each specimen to determine the minimum shaft travel required to close the specimen. This shall be accomplished by establishing a 10 gpm flow of MIL-H-5606 hydraulic fluid pressurized at 1500 psig, through the specimen. The specimen shall then be closed and the minimum shaft travel required to stop the flow measured.

10.2 TEST PROCEDURE

10.2.1 The specimen was installed as shown in figures 10-1 and 10-2 utilizing the equipment listed in table 10-1. A test reference view is shown in figure 10-3.

10.2.2 It was determined that all connections were tight, all gages were installed and operating properly, and all valves were closed.

10.2.3 Pump 2 was started and the outlet pressure as indicated by gage 3, was adjusted to 1500 psig. Hand valves 6 and 7 were slowly opened until a 10 gpm flow was indicated by flowmeters 4 and 5.

10.2.4 Hand valve 11 and solenoid valve 9 were opened and regulator 10 was adjusted until the specimen closed. Shaft travel, indicated by dial indicator 13 was recorded.

10.2.5 Hand valves 6 and 7 were closed. Hand valves 14 and 15 were opened to determine that specimen was closed and there is no internal leakage.

10.2.6 Hand valves 14 and 15 and regulator 10 was closed. Solenoid valve 9 was actuated, cylinder 8 vented and pump 2 was then shut down.

10.2.7 The specimen was installed in reverse to that shown in figure 10-1 thus, flow through the specimen was reversed. Steps 10.2.2 through 10.2.6.

10.3 TEST RESULTS

The minimum shaft travel to stop flow was determined.

10.4 TEST DATA

Data recorded during the test are presented in tables 10-2 through 10-7.

Table 10-1. Repeatability Test Equipment List

Item No.	Item	Manufacturer	Model Part No.	Serial No.	Remarks
1	Specimen	Flodyne Controls Inc	5C151	1, 4 and 9	
2	Pump	Denison Eng. Corp.	PV08-035-51-L-02	3833	0 to 3000 psig
3	Pressure Gage	Marsh Instrument Co.	NA	95-11843	0 to 3000 psig Cal. date 11-28-67
4	Flowmeter	Cox	AN-12	019167	0 to 30 gpm Cal. date 1-25-68
5	Flowmeter	Waugh	FL-12-SR1	106-1030B	0 to 20 gpm Cal. date 11-4-67
6	Hand Valve	Vacco Valve Co.	NV-6P-403-2	NA	$\frac{1}{2}$-inch
7	Hand Valve	Vacco Valve Co.	NV-6P-403-2	NA	$\frac{1}{2}$-inch
8	Cylinder	Parker-Hannfin	CC-2AS14C	F 95985	2-inch bore
9	Solenoid	Marotta Valve Co.	MV-74V	824	$\frac{1}{4}$-inch
10	Regulator	Grove Valve Regulator Co.	15-LXH	L-41407	0 to 3000 psig range
11	Hand Valve	Robbins Aviation	SSKG-250-4T	NA	$\frac{1}{4}$-inch
12	Pressure Gage	Ashcroft Corp.	NA	95-1403	0 to 200 psig Cal. date 10-14-67
13	Dial Indicator				
14	Hand Valve	Robbins Aviation	SSKG-250-4T	NA	$\frac{1}{4}$-inch
15	Hand Valve	Robbins Aviation	SSKG-25-4T	NA	$\frac{1}{4}$-inch
16	Graduated Beaker	CCSD			
17	Graduated Beaker	CCSD			
18	Pressure Gage	Acco Helicoid	NA	200506-AA	0 to 500 psig Cal. date 9-26-67
19	Reservoir	CCSD			

Table 10-2. Repeatability Test Data Specimen 1

TEST DATA SHEET Specimen No. 1				
FLOW DIRECTION	TEST MEDIA	PRESSURE (psig)	FLOW (gpm)	SHAFT TRAVEL TO STOP FLOW (inches)
Inlet	Mil-H-5606	1500	10	Ball # 1 Run 1 .379 Run 2 .373 Run 3 .375 Ball # 2 Run 1 .391 Run 2 .390 Run 3 .390

Table 10-3. Repeatability Test Data Specimen 1

TEST DATA SHEET Specimen No. 1				
FLOW DIRECTION	TEST MEDIA	PRESSURE (psig)	FLOW (gpm)	SHAFT TRAVEL TO STOP FLOW (inches)
Outlet	Mil-H-5606	1500	10	Ball # 1 Run 1 .372 Run 2 .373 Run 3 .375 Ball # 2 Run 1 .390 Run 2 .393 Run 3 .392

Table 10-4. Repeatability Test Data Specimen 2

TEST DATA SHEET Specimen No. 2				
FLOW DIRECTION	TEST MEDIA	PRESSURE (psig)	FLOW (gpm)	SHAFT TRAVEL TO STOP FLOW (inches)
Inlet	Mil-H-5606	1500	10	Ball # 1 Run 1 .370 Run 2 .369 Run 3 .369 Ball # 2 Run 1 .372 Run 2 .371 Run 3 .370

Table 10-5. Repeatability Test Data Specimen 2

TEST DATA SHEET Specimen No. 2				
FLOW DIRECTION	TEST MEDIA	PRESSURE (psig)	FLOW (gpm)	SHAFT TRAVEL TO STOP FLOW (inches)
Outlet	Mil-H-5606	1500	10	Ball # 1 / Ball # 2 Run 1 .366 / Run 1 .370 Run 2 .365 / Run 2 .373 Run 3 .367 / Run 3 .372

Table 10-6. Repeatability Test Data Specimen 3

TEST DATA SHEET Specimen No. 3				
FLOW DIRECTION	TEST MEDIA	PRESSURE (psig)	FLOW (gpm)	SHAFT TRAVEL TO STOP FLOW (inches)
Inlet	Mil-H-5606	1500	10	Ball # 1 / Ball # 2 Run 1 .397 / Run 1 .406 Run 2 .394 / Run 2 .405 Run 3 .393 / Run 3 .403

Table 10-7. Repeatability Test Data Specimen 3

TEST DATA SHEET Specimen No. 3				
FLOW DIRECTION	TEST MEDIA	PRESSURE (psig)	FLOW (gpm)	SHAFT TRAVEL TO STOP FLOW (inches)
Outlet	Mil-H-5606	1500	10	Ball # 1 / Ball # 2 Run 1 .393 / Run 1 .403 Run 2 .393 / Run 2 .402 Run 3 .394 / Run 3 .404

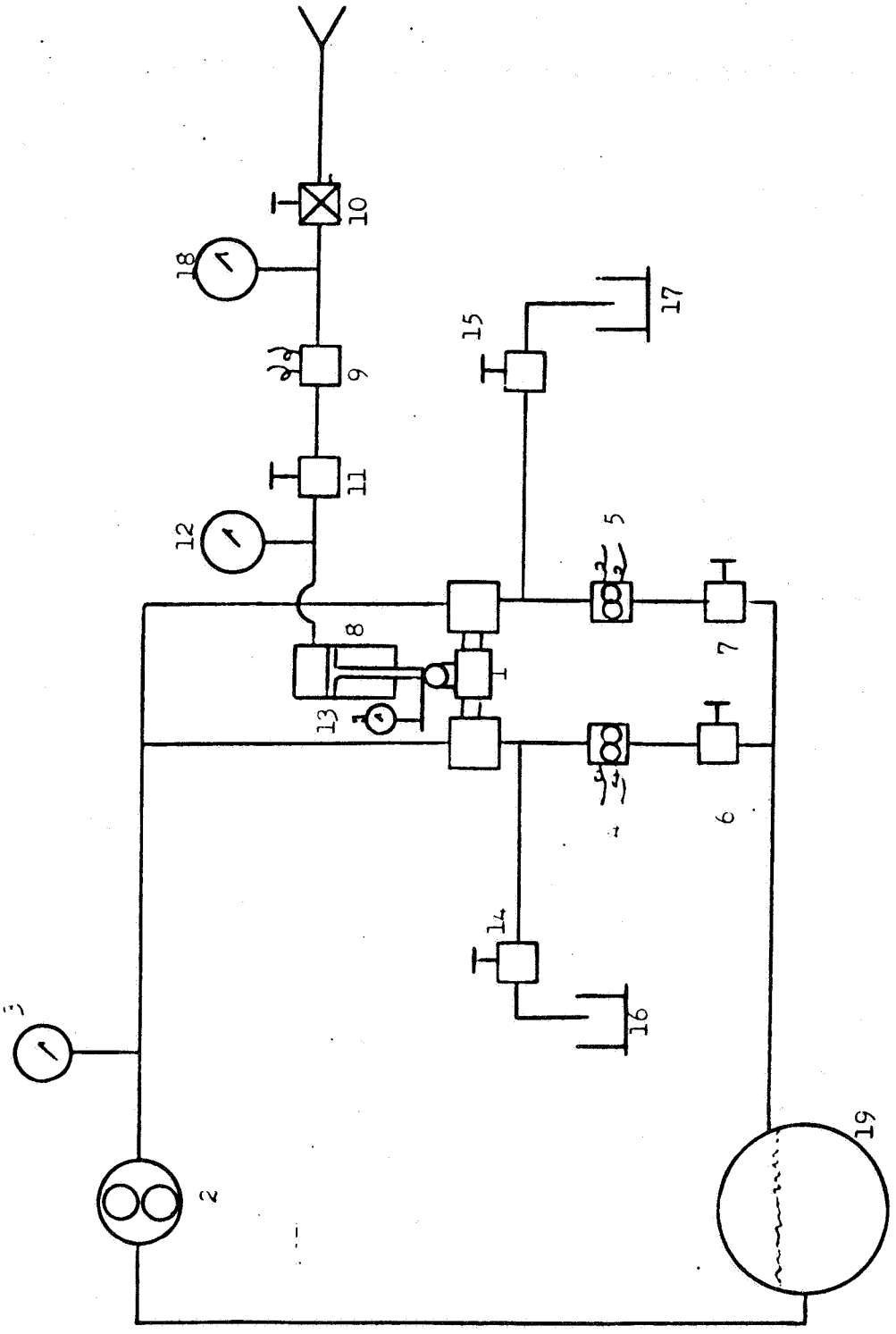


Figure 10-1. Repeatability Test Schematic

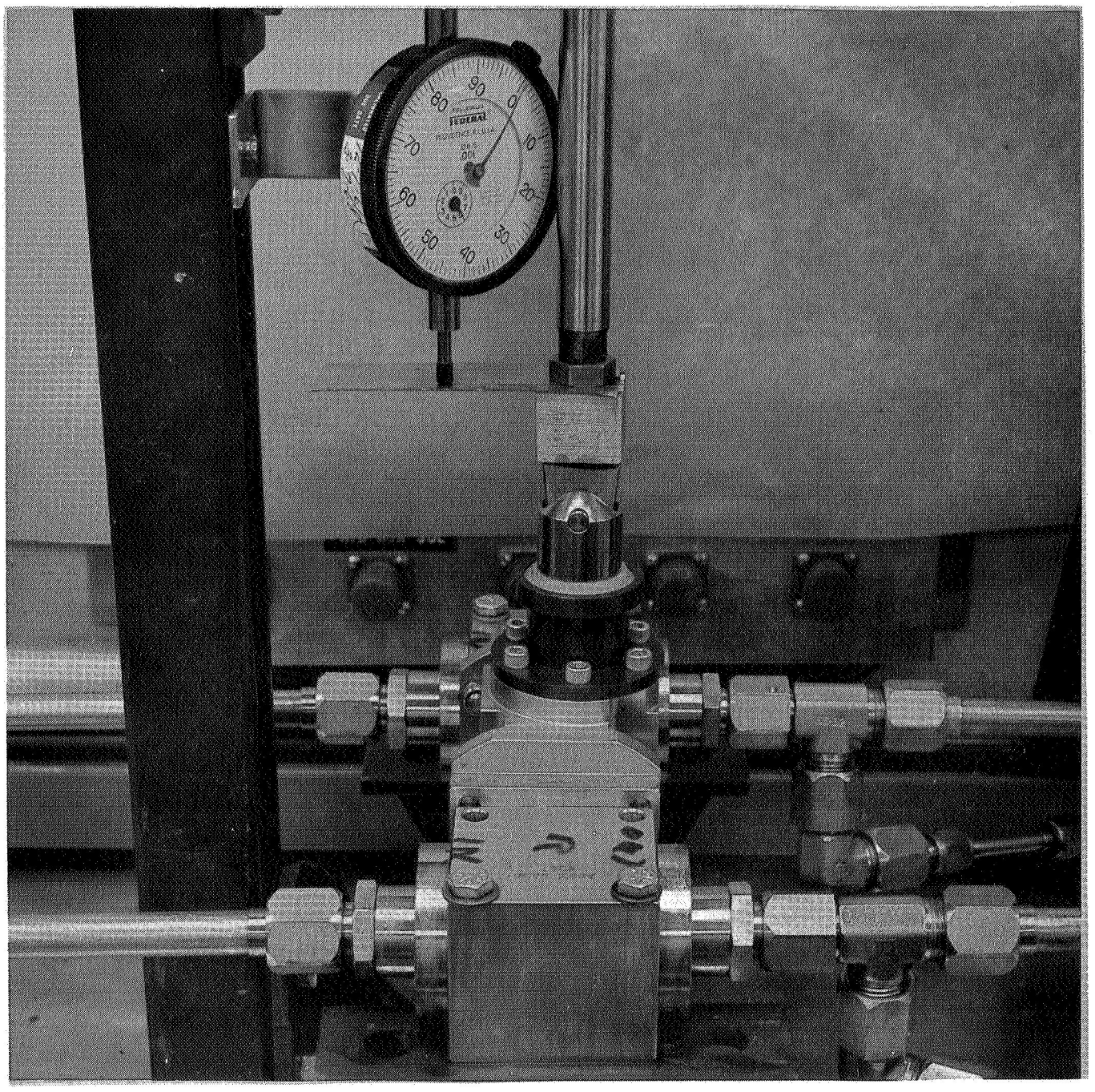


Figure 10-2. Setup For Measuring Shaft Travel During Repeatability Test

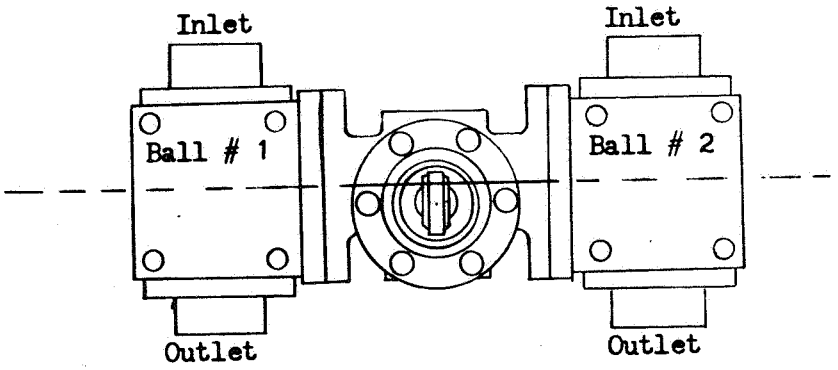


Figure 10-3. Test Reference View

SECTION XI

SHAFT TRAVEL AND BALL ROTATION TEST

11.1 TEST REQUIREMENTS

11.1.1 A shaft travel and ball rotation test shall be conducted on each specimen to determine shaft travel versus ball rotation from the full open to the full closed position.

11.2 TEST PROCEDURE

11.2.1 Each specimen was installed as shown in figure 11-1, utilizing the equipment listed in table 11-1.

11.2.2 It was determined the specimen was in the full open position and the recording equipment was set at zero.

11.2.3 Using press 4, the specimen was actuated from zero to 0.550-inch shaft travel in increments of 0.050-inch maximum. The degree of ball rotation was recorded at each increment.

11.3 TEST RESULTS

Shaft travel versus ball rotation was recorded and plotted. There were no significant differences in data received from the three specimens. A disassembled view of a specimen is shown in figure 11-5.

11.4 TEST DATA

Data, obtained during the test, are presented graphically in figures 11-2 through 11-4.

Table 11-1. Shaft Travel and Ball Rotation Test Equipment List

Item No.	Item	Manufacturer	Model Part No.	Serial No.	Remarks
1	Specimen	Flodyne Controls Inc.	5C151	1, 4 and 9	Dual Ball Valve
2	Combination Compass Square	Brown & Sharpe	NA	95-1406B	
3	Dial Indicator	L. S. Starrett Co.	NA	66-1174A	Cal. date 2-7-68
4	Press	Drake Arbor Press	101-$\frac{1}{2}$	NA	

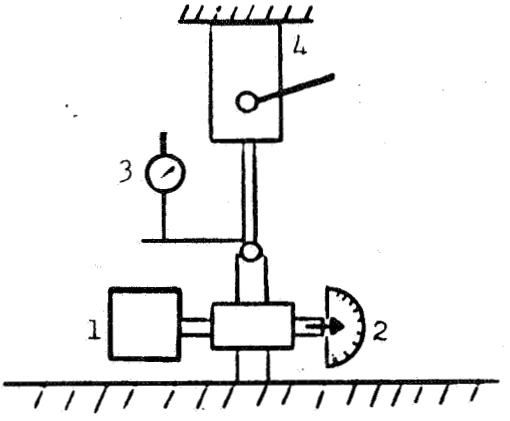


Figure 11-1. Shaft Travel And Ball Rotation Test Schematic

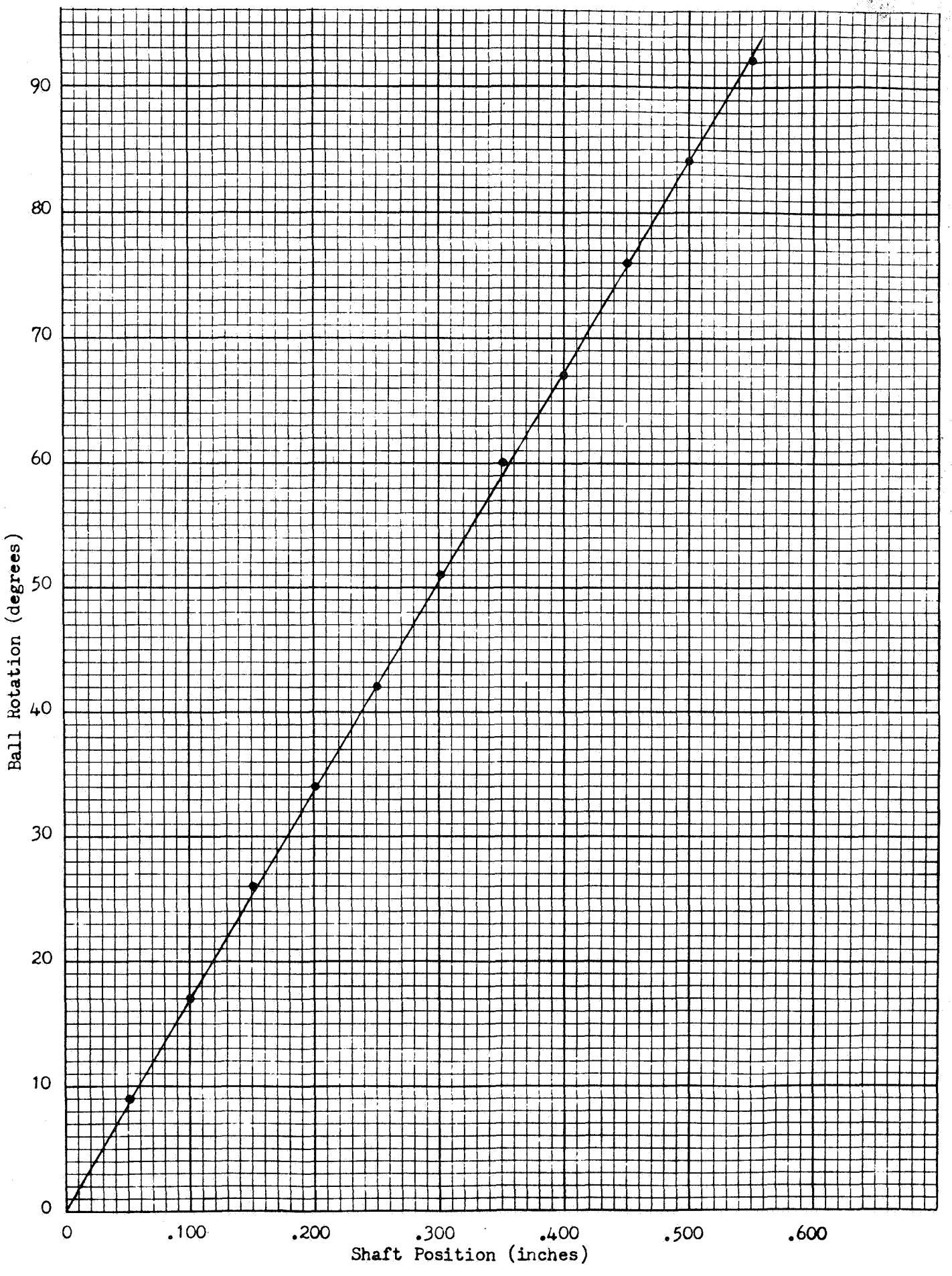


Figure 11-2. Shaft Travel versus Ball Rotation Specimen 1

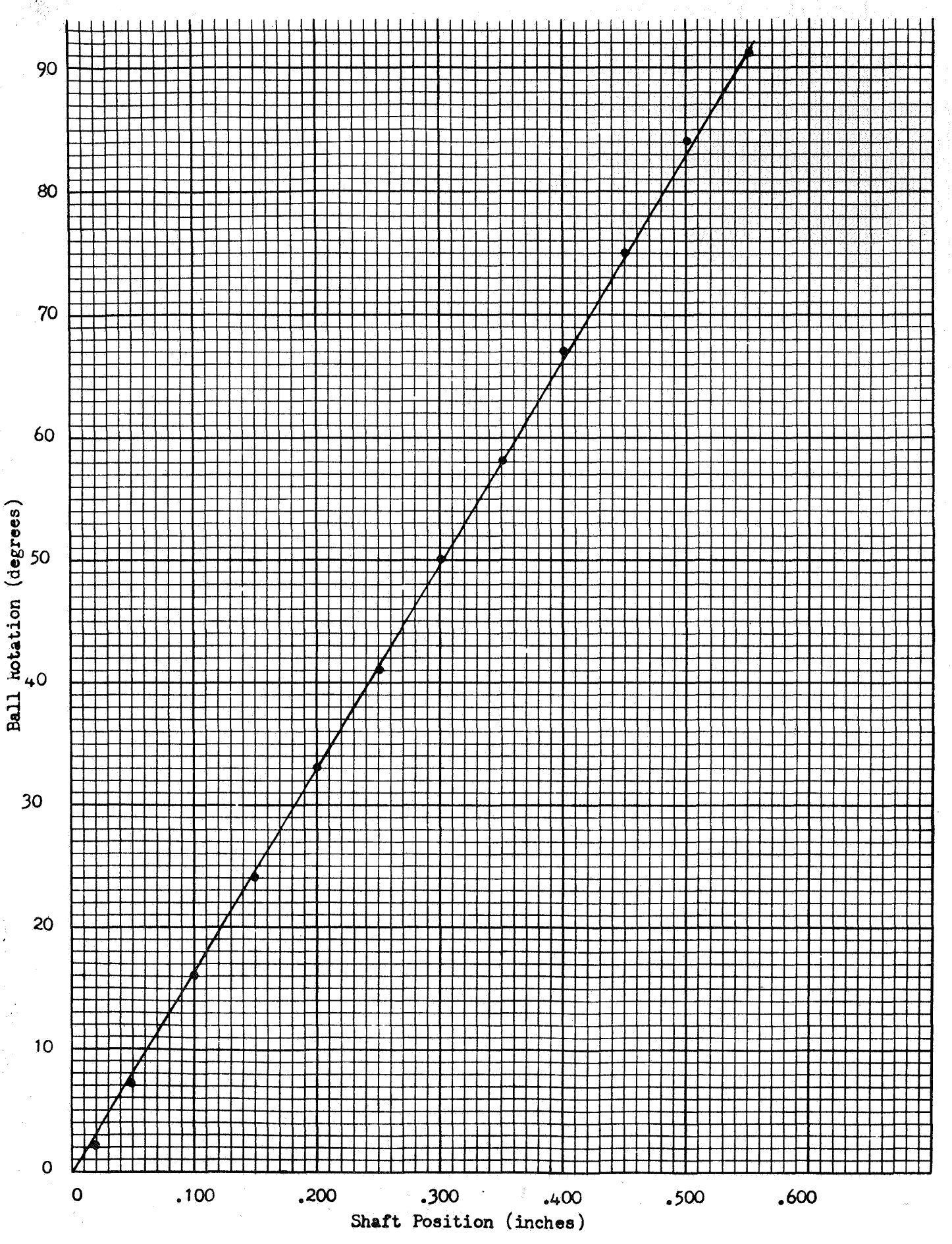


Figure 11-3. Shaft Travel versus Ball Rotation Specimen 2

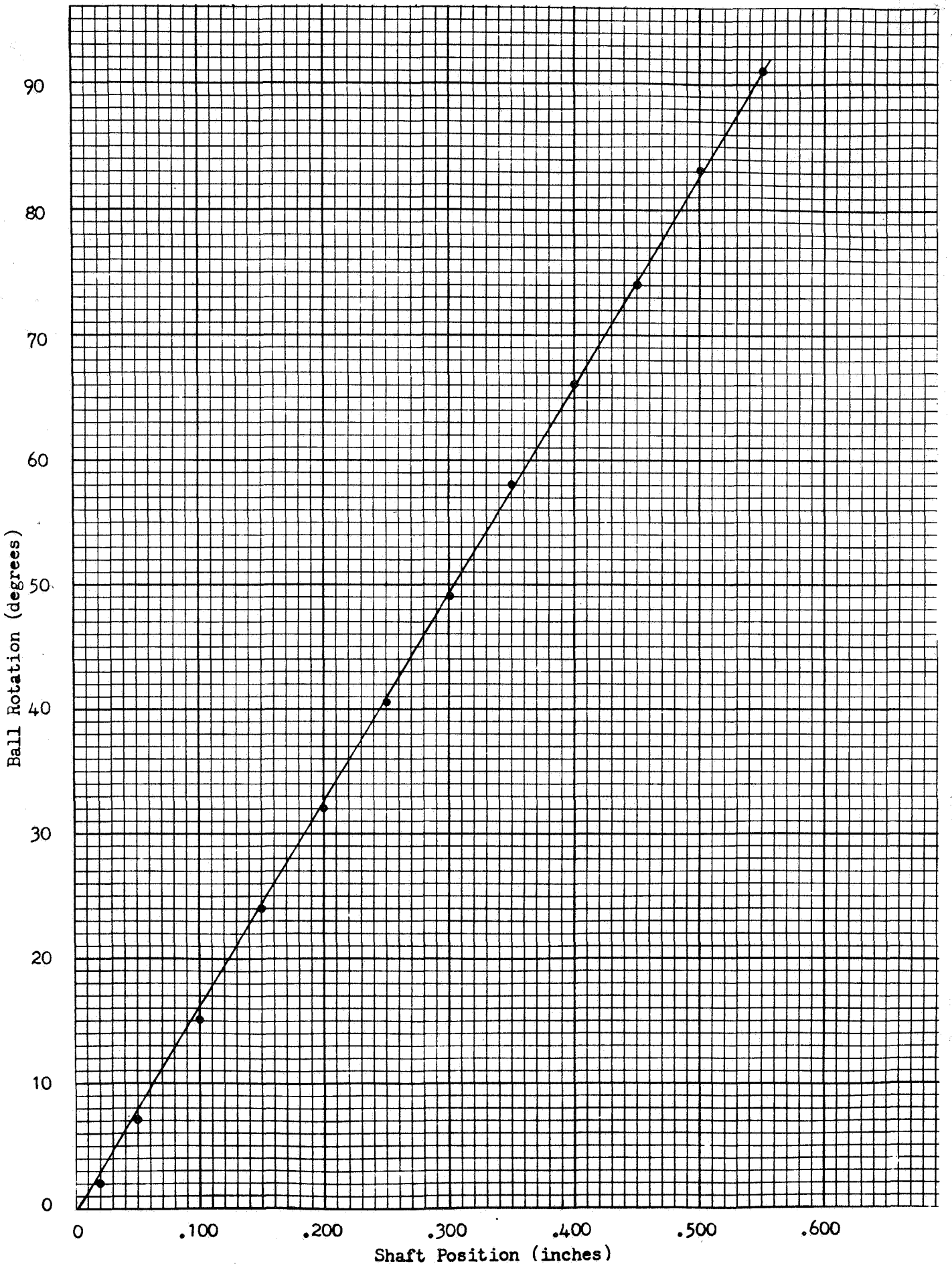


Figure 11-4. Shaft Travel versus Ball Rotation Specimen 3

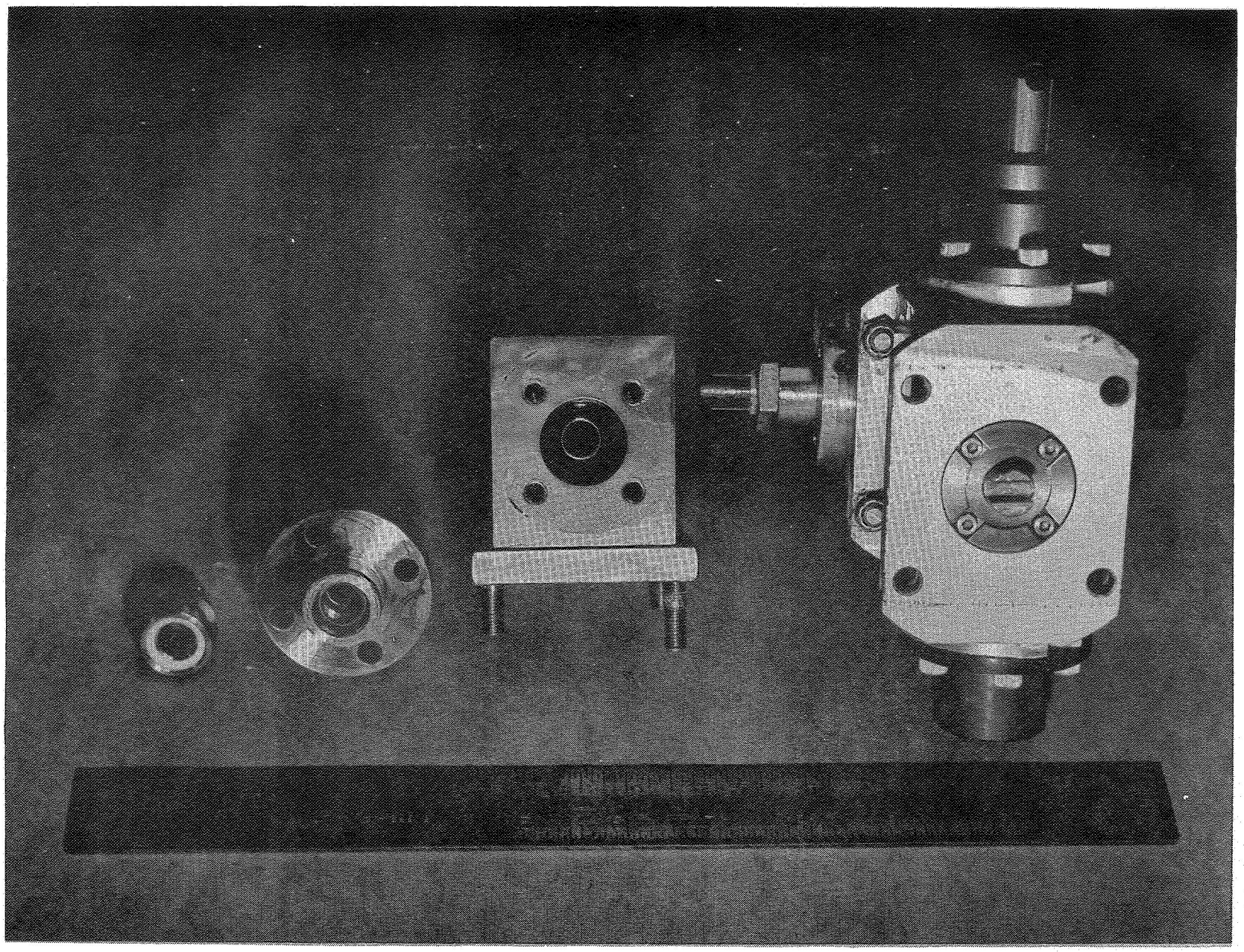


Figure 11-5. Specimen Disassembled For Shaft Travel Versus Ball Rotation Test

SECTION XII

FLOW TEST

12.1 TEST REQUIREMENTS

12.1.1 A flow test shall be conducted on the test specimen to determine flow versus shaft travel at a differential(ΔP) of 1500 psig across the specimen. This shall be accomplished by using MIL-H-5606 hydraulic fluid as the pressure medium and closing the specimen until a ΔP of 1500 psig across the specimen can be established. The flow and shaft travel shall be measured at this position and in increments of 0.020-inch shaft travel until the specimen is fully closed while maintaining a ΔP of 1500 psig.

12.2 TEST PROCEDURE

12.2.1 Specimen number 1 was installed as shown in figure 12-1 utilizing the equipment listed in table 12-1.

12.2.2 It was determined that all connections were tight, all gages were operating properly, and all valves were closed.

12.2.3 The specimen and hand valves 4, 6, and 8 were opened.

12.2.4 Pump 2 was started and the pump outlet pressure, indicated by gage 3, was adjusted to 2000 psig.

12.2.5 Hand valve 13 was opened and regulator 16 and hand valve 8 were adjusted until a ΔP of 1500 psig, indicated by gages 3 and 5, could be established across the specimen. The flow and shaft travel were measured at this position and also at shaft travel increments of 0.020-inch until the specimen closed. A ΔP of 1500 psig was maintained.

12.2.6 Hand valve 8 and regulator 16 were closed, hand valve 14 was opened, cylinder 11 vented and pump 2 was then shut down.

12.3 TEST RESULTS

Flow data were recorded from 0.290-inch to 0.370-inch at 0.020 increments of shaft travel while maintaining a ΔP of 1500 psig across the specimen.

12.4 TEST DATA

Flow versus shaft position is presented graphically in figure 12-2.

Table 12-1. Flow Test Equipment List

Item No.	Item	Manufacturer	Model Part No.	Serial No.	Remarks
1	Specimen	Flodyne Controls Inc.	5C151	1	
2	Pump	Denison Eng. Corp.	PV08-035-51-L-02	3833	0 to 3000 psig
3	Pressure Gage	Hese	NA	015537	0 to 500C psig Cal. date 1-27-68
4	Hand Valve	Robbins	SSKG-250-4T	NA	$\frac{1}{4}$-inch
5	Pressure Gage	Ashcroft Duragage		95-1211-B	0 to 3000 psig Cal. date 11-10-67
6	Hand Valve	Robbins Aviation	SSKG-250-4T	NA	$\frac{1}{4}$-inch
7	Flowmeter	Waugh	FL-12-SR1	106-103013	$\frac{1}{2}$-inch, 20 gpm Cal. date 11-4-67
8	Hand Valve	Vacco Valve Co.	NV-6P-403-2	NA	$\frac{1}{2}$-inch
9	Reservoir	CCSD			
10	Dial Indicator	Starrett Co.	NA	66-1174A	Cal. date 2-7-68
11	Cylinder	Parker-Hannfin	CC-2AS14C	F-95985	2-inch bore
12	Pressure Gage	Ashcroft Corp.	NA	95-1403	0 to 200 psig Cal. date 10-14-67
13	Hand Valve	Robbins Aviation	SSKG-250-4T	NA	$\frac{1}{4}$-inch
14	Vent Valve	Robbins Aviation	SSKG-250-4T	NA	$\frac{1}{4}$-inch
15	Pressure Gage	Acco Helicoid	NA	200506-AA	0 to 500 psig Cal. date 9-26-67.
16	Regulator	Grove Valve & Regulator Co.	15LXH	L-41407	0 to 3000 psig

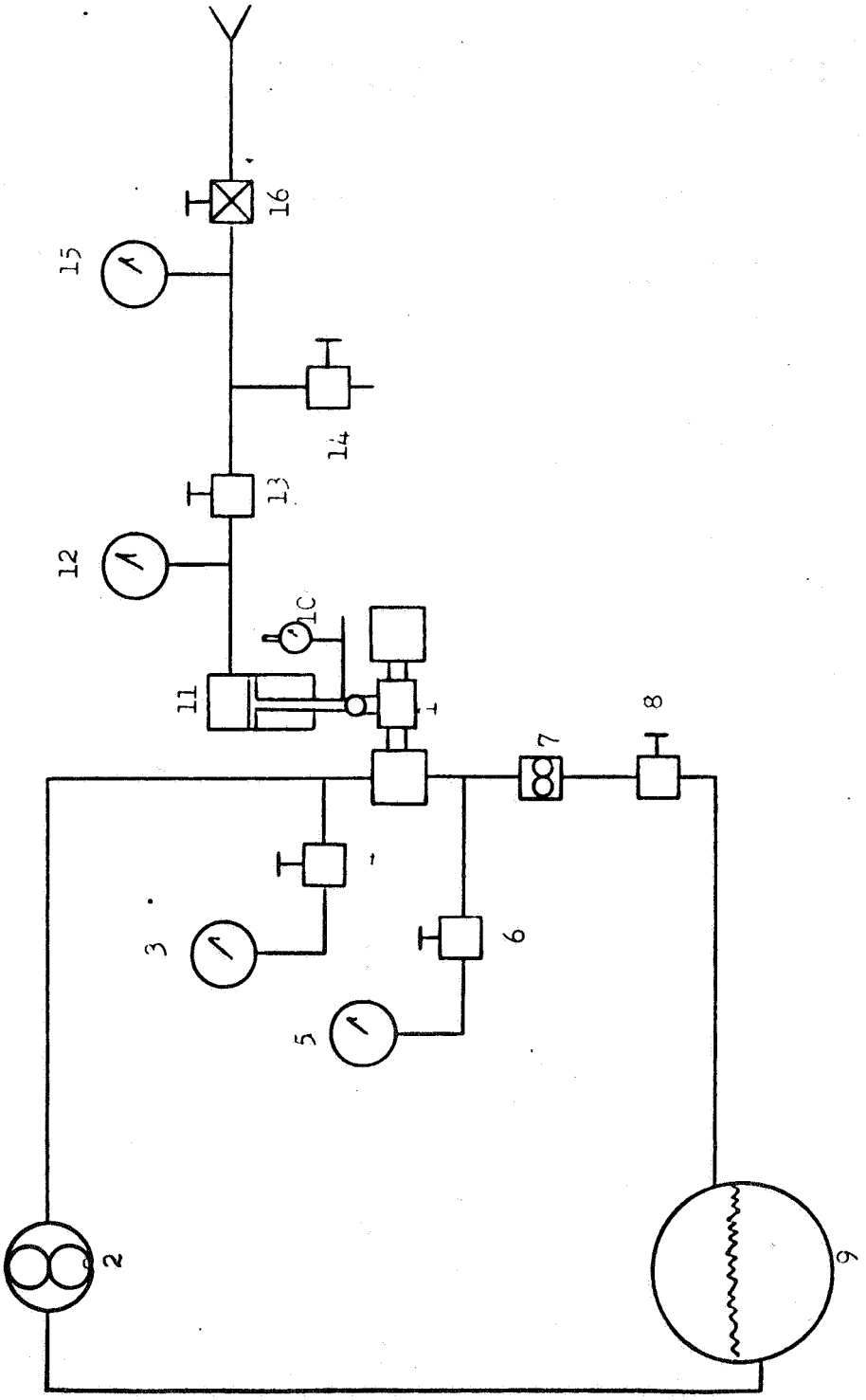


Figure 12-1. Flow Test Schematic

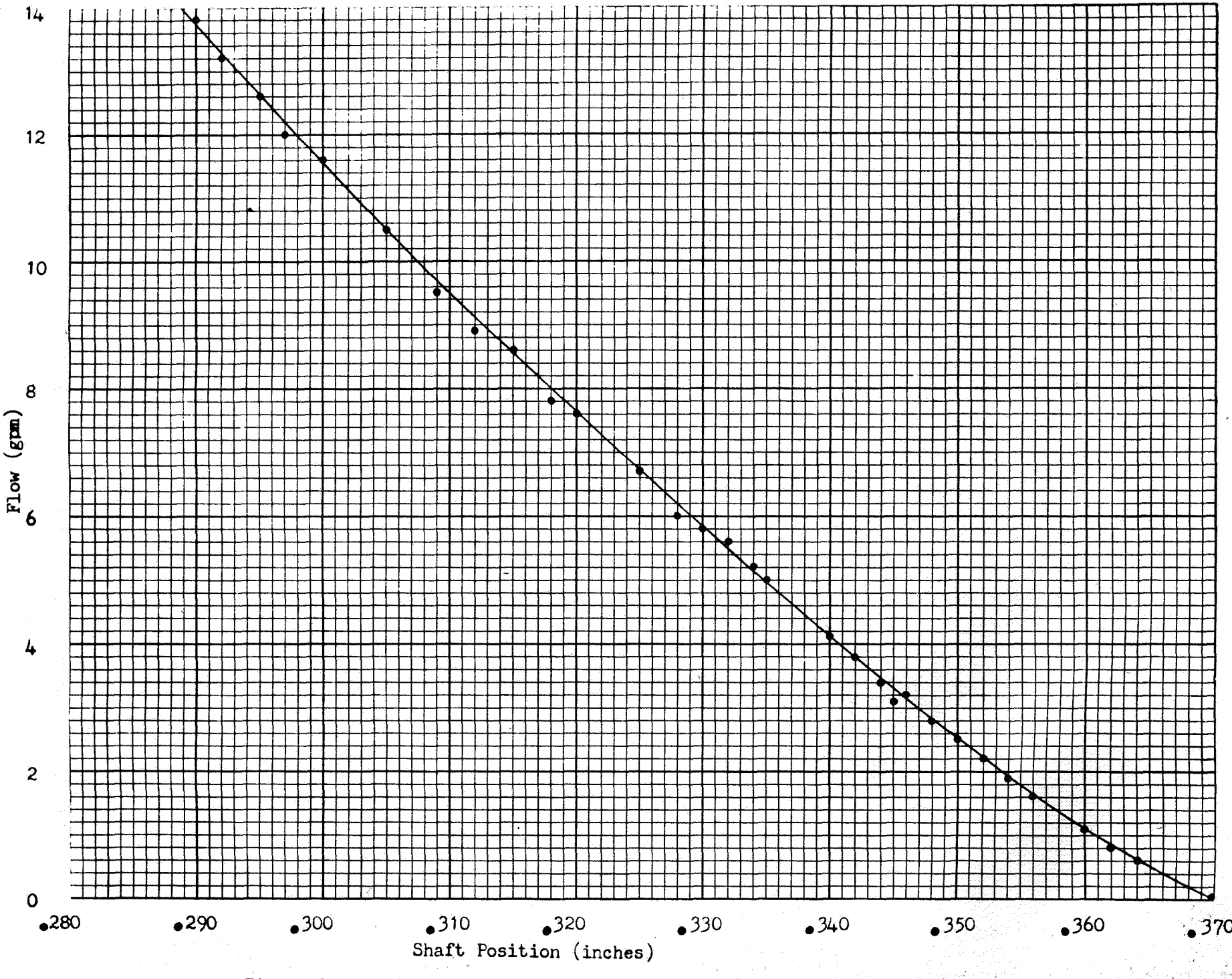


Figure 12-2. Flow versus Shaft Position Ball # 2 Specimen 1

SECTION XIII

BURST TEST

13.1 TEST REQUIREMENTS

13.1.1 A burst test shall be conducted on two specimens. Each specimen shall be in the open position and pressurized with MIL-H-5606 hydraulic fluid to 4500 psig for 5 minutes.

13.1.2 A leakage test shall be conducted on the two specimens. Each specimen shall be in the closed position with the inlet ports pressurized to 1500 psig and then with the pressure increased to 4500 psig.

13.2 TEST PROCEDURE

13.2.1 Specimen number 1 and 2, each was installed as shown in figures 13-1, 3-2 and 3-3, utilizing the equipment listed in table 13-1.

13.2.2 It was determined; all connections were tight, gages were installed operating properly, and that all valves were closed.

13.2.3 The specimen and hand valves 3 and 5 were opened.

13.2.4 Using hand pump 2, MIL-H-5606 hydraulic fluid was pumped until the test setup and specimen were free of air.

13.2.5 Hand valve 5 was closed and the specimen was pressurized until 4500 psig was indicated by gage 4. This pressure was maintained for 5 minutes while the specimen was examined for external leakage and distortion.

13.2.6 Hand valve 5 was opened and the specimen and test setup vented.

13.2.7 The line connecting the specimen outlet ports was removed and leak check lines were then installed.

13.2.8 The specimen and hand valve 5 were closed.

13.2.9 Using hand pump 2, the specimen was pressurized until 1500 psig was indicated by gage 4. This pressure was maintained for 5 minutes while the leakage into graduated cylinders 7 and 8 was monitored.

13.2.10 The specimen pressure was increased to 4500 psig. This pressure was maintained for 5 minutes while the leakage into graduated cylinders 7 and 8 was monitored.

13.3 TEST RESULTS

13.3.1 No visible leakage or distortion occurred during the burst tests.

13.3.2 Test results were considered satisfactory.

13.4 TEST DATA

Burst test data are presented in table 13-2.

Table 13-1. Burst Test Equipment List

Item No.	Item	Manufacturer	Model Part No.	Serial No.	Remarks
1	Specimen	Flodyne Controls Inc.	5C151	1 and 4	
2	Hand Pump	W. S. Pine Inc.	160-3	NA	0 to 5000 psig
3	Hand Valve	Robbins Aviation	SSKG-250-4T	NA	$\frac{1}{4}$-inch
4	Pressure Gage	Heise	NA	015537	0 to 5000 psig $\pm$ 0.1% FS Cal. date 1-22-68
5	Hand Valve	Robbins Aviation	SSKG-250-4T	NA	$\frac{1}{4}$-inch
6	Burst Chamber	CCSD	NA	201344	3 ft by 3 ft by 3 ft.
7	Graduated Cylinder	CCSD	NA	NA	
8	Graduated Cylinder	CCSD	NA	NA	

Table 13-2. Burst Test Data

Test Specimen	Burst Pressure Specimen Open (psig)	Burst Pressure Specimen Closed (psig)	Pressurization Time Each Position	Leakage
1	4500	1500 and 4500	5 minutes	None
2	4500	1500 and 4500	5 minutes	None

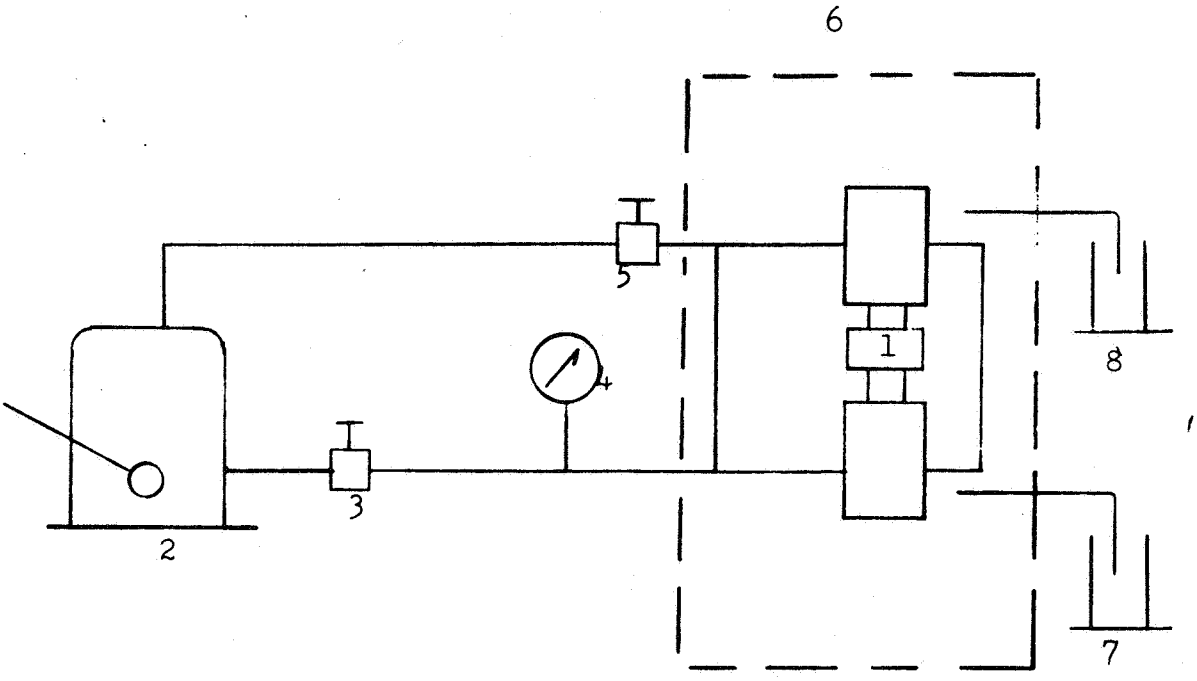


Figure 13-1. Burst Test Schematic

APPROVAL

TEST REPORT

FOR

DUAL BALL SHUTOFF VALVE, ½ INCH, 1500 PSIG, CAM OPERATED

Flodyne Controls Inc., Part Number 5C151

NASA Drawing Number 75K26264

SUBMITTED BY: _____

T. W. SPARKS
Test and Evaluation Section
Chrysler Space Division
Michoud Assembly Facility

APPROVED BY: _____

R. W. CLAUNCH
Program Supervisor
Chrysler Space Division
Michoud Assembly Facility

APPROVED BY: _____ for

V. J. VEHKO, Director
Engineering Department

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